Pre-Project Planning of Capital Facilities at NASA

by

Benjamin John Barrow, B.S.M.E., P.E.

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Approved by
Supervising Committee:

G. Edward Gibson, Jr.

Richard L. Tucker

Dedication

This thesis is dedicated to my loving wife, Monique, who constantly presents me with life's most exquisite experiences. You are the manifestation of absolute love, patience, strength, peace and truth. I remain eternally grateful to you. I would also like to recognize the unfailing love and support of my extended family; Jim and Nancy Marasco, Dan and Monica Mustard, Jimmy and Jodi Marasco, Irene Brekelmans, Andrew and Danetta Barrow, and Frank and Barbara Harris.

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Abstract

Pre-Project Planning of Capital Facilities at NASA

Benjamin John Barrow, M.S.E.

The University of Texas at Austin, 1999

Supervisor: G. Edward Gibson, Jr.

This thesis details the development of a NASA-specific Project Definition Rating Index (PDRI) tool. This tool is to be used as a checklist for determining the necessary steps to follow in defining project scope and as a means to monitor progress and assess scope definition completeness at various stages during the NASA Pre-Project Planning process. This thesis also describes and identifies specific points in the NASA Capital Facility Programming Cycle for the performance of PDRI assessments.

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Chapter 1: Introduction

The facilities group at the National Aeronautics and Space Administration (NASA), through the Johnson Space Center (JSC), expressed interest to the University of Texas in obtaining assistance in the adaptation and implementation of proven pre-project planning techniques and tools into their agency-wide capital facilities program. As NASA is confronted with progressively aging facilities, major emphasis is now being placed on revitalization; the renewal effort applied to the existing overall facility base that extends the useful service life beyond the original design life. The expectations for facilitation and assistance include the following:

- Instruction on the current "best practices" in pre-project planning.
- Development of NASA-specific pre-project planning tools to assist with the planning of all types of projects including revitalization.
- Integration of the developed tools with NASA strategic planning and capital budget cycles.
- Formalization and standardization of pre-project planning efforts.

It has been confirmed that the greater the pre-project planning effort, the greater the chance for project success. Pre-project planning is defined as the process of developing sufficient strategic information for project owners to address risk and decide to commit resources to maximize the chance for a

successful project. Pre-project planning effort involves aligning the project team with the mission needs of the facility and developing an adequate scope definition. Research conducted by the Construction Industry Institute (CII) Pre-Project Planning Research team indicated that well-performed pre-project planning can: reduce project costs by as much as 20 percent, lead to less project variability in terms of cost, schedule, and operating characteristics, and increase the chance of meeting a project's environmental and social goals. The research also indicates a direct relationship between project success and the level of pre-project planning effort. (CII 1995) Poor scope definition has also been shown to be a major cause of actual project "disasters." (CII 1997)

Until recently, the building industry has lacked non-proprietary tools to assist in measuring the completeness of project scope definition. Two Project Definition Rating Index (PDRI) tools have been developed by the (CII) to assist project teams in developing a complete project definition package. One applies to Building projects and the other to Industrial projects. The term "building projects" refers to single or multi-story commercial, institutional or light industrial facilities such as offices, banks, dormitories, warehouses, schools and apartments. The PDRI tools are easy-to-use weighted checklists that contain scope definition elements. Numerical scoring is achieved through the estimation of the degree of definition of each of the numerous elements. The lower the score the better defined a project is. Both PDRI tools have been validated in industry and proven to be extremely valuable. These tools establish the starting basis for the development of a NASA-specific PDRI.

1.1 SCOPE

Two deliverables will be developed as a result of this thesis. To begin with, a NASA-specific Project Definition Rating Index (PDRI) tool for building revitalization projects will be developed from the following general steps. The first step consists of modifying the existing CII Buildings PDRI into an element check sheet format. Next, a meeting with representation by experts from the facilities planning departments of all of NASA's space centers will be held to check each element for validity with current NASA revitalization processes and annotate any relevant NASA specific procedures, problems or required documentation. This NASA-specific PDRI prototype will then be distributed and analyzed by members of each space center. After incorporating feedback into the prototype, it will be validated by its use in accessing the planning efforts of actual projects at NASA.

The second deliverable will be a time-phased schedule illustrating recommended points throughout the NASA facilities budget cycle to execute pre-project planning measurements. This will be developed through meetings and discussions with facility planning experts from each of the space centers.

1.2 OBJECTIVES

This thesis is directed at the fulfillment of three main objectives listed below in order of relative precedence.

1. Develop a NASA-specific Project Definition Rating Index (PDRI) tool to be used as a checklist for determining the necessary steps to follow in defining project scope and as a means to monitor progress at various stages during the pre-

project planning effort. Included in this objective is an examination of the capability for adaptation of the existing CII Building PDRI for use on projects not involving new construction; namely, revitalization projects.

2. Develop a standardized process for the timing of PDRI evaluations within NASA's budgetary programming guidelines.

3. Demonstrate the possibility for a successful adaptation of the CII pre-project planning practices and tools at a government agency level. It is likely that the adaptation at other government agencies would share similar phases and potential for benefit.

1.3 THESIS ORGANIZATION:

This thesis will detail the development of the NASA-specific PDRI tool from idea origination to the author's conclusions and recommendations about its applicability and usage. Chapter 2 gives the background of the research including a synopsis of CII's research into pre-project planning as well as other related publications. Research methodology is presented in Chapter 3. Chapter 4 discusses the developed NASA specific PDRI and its usage and validation. NASA pre-project planning timelines including recommended PDRI evaluation points are presented in Chapter 5. Finally, Chapter 6 contains the author's conclusions and recommendations about the developments and use of the NASA-specific PDRI.

Chapter 2: Background

2.1 Introduction

This chapter details the organizations, events, and literature providing background for the development of a NASA-specific PDRI tool for building revitalization of projects. In general, this thesis has been part of an overall effort by the Construction Industry Institute (CII) to facilitate front-end planning on construction projects. Over the past eight years, CII has funded three pre-project planning research projects that have resulted in numerous publications and implementation tools. Of these publications, two, *The Pre-Project Planning Handbook* (1995) and *The Project Definition Rating Index for Building Projects* (1999), are closely tied to the background of this project. In addition to a description of CII and CII publications, mention of other relevant literature to this research are covered in the final section.

2.2 The Construction Industry Institute

Located at the University of Texas at Austin, the Construction Industry Institute (CII) is a research organization whose mission is:

> "To improve the safety, quality, schedule, and cost effectiveness of the capital investment process through research and implementation support for the purpose of providing competitive advantage to its members in the global marketplace (CII 1999a)."

CII was established in 1983 in order to improve the safety, quality, schedule, and cost effectiveness of the capital investment process. It is a

consortium of leading owners and contractors who have joined together to find better ways of planning and executing capital construction programs (CII 1999a).

CII is funded by an annual grant from each of its member companies. Each year, research teams are organized by CII's Board of Advisors to explore new areas of study within the six areas of concentration: research, implementation, education, benchmarking, globalization, and breakthrough research. The teams are composed of industry professionals from the member companies as well as an academic expert in the subject area who is the principal investigator for the research team. Since 1985, CII has established over 85 research teams including collaboration with over 35 universities.

2.3 PRE-PROJECT PLANNING HANDBOOK

The *Pre-Project Planning Handbook* was published in April of 1995 as a result of the Pre-Project Planning Research Team that was commissioned by CII in 1991. Geared toward industrial projects, it takes the user through the steps of pre-project planning using a high-level process map. The pre-project planning steps as stated in the book are:

1. Organize for Pre-Project Planning
2. Select Project Alternatives
3. Develop a Project Definition Package
4. Decide Whether to Proceed with Project

The first step, Organize for Pre-Project Planning, has a phase that is titled, "Prepare Pre-Project Planning Plan." Here, the text provides a list of suggested components that might make up a pre-project plan. The majority of these

elements are included in the NASA pre-project planning timeline and the developed NASA-specific PDRI will measure their degree of completeness.

2.4 PDRI FOR INDUSTRIAL PROJECTS

The Project Definition Rating Index (PDRI) for Industrial Projects was developed in 1995 by a sub-team of the Front End Planning Research Team that was chartered by CII in 1994. Industrial projects include such facilities as chemical, gas production, paper, power and manufacturing plants that range from one or two million dollars to hundreds of millions of dollars. The PDRI for Industrial Projects is a tool for measuring project scope development based on industry best practices and a methodology for benchmarking the degree of scope development through the use of a weighted index (Dumont 1995). The PDRI for Industrial Projects was envisioned to be used from the beginning of initial feasibility studies to the completion of design development.

The PDRI for Industrial Projects consists of a weighted list of 70 scope definition elements. The elements may be scored in one of six definitions from 0 to 5; 0 if not applicable, 1 if perfectly defined, and so on until a score of 5 which represents totally undefined. Therefore, a project could theoretically receive a score that ranged from 1000 for a totally undefined project to a perfectly defined score of around 70 depending on which elements are not applicable.

The final step of the PDRI for Industrial Projects development was validation. Even though the PDRI weights were based upon the expertise of industry professionals, the research team felt the tool should be tested on a sample of actual projects. For the validation, 40 projects that varied in cost from $1

million to $635 million were used. Based on these "after the fact" projects, a 'par value' of 200 points was defined that showed a strong delineation of project outcome. Projects that scored below 200 averaged 5% below budget, 1% ahead of schedule and 2% change orders. Projects above 200 averaged 14% above budget, 12% behind schedule and 8% change orders (CII 1997). In summary, this research proved the enormous potential of a tool to quantitatively define scope definition on construction projects and paved the way for further studies about pre-project planning in other construction industry sectors.

2.5 PDRI FOR BUILDING PROJECTS

In 1998 based on the success of the PDRI for Industrial Projects and industry interest, CII formed the Project Definition Rating Index for Building Projects Research Team. The scope of this team's research was limited to developing a scope definition tool for building projects (excluding residential houses) in the public and private sector (Gibson 1998). Unlike the scope definition and design of industrial projects that focuses on process and equipment specifications designed by process engineers, building projects are generally planned and designed by an architect for an owner's specified use. However, both types of projects are similar in the regard that the level of pre-project planning can have a tremendous impact on project outcomes. The following figure shows the typical parts of a building project's lifecycle where the PDRI is applicable.

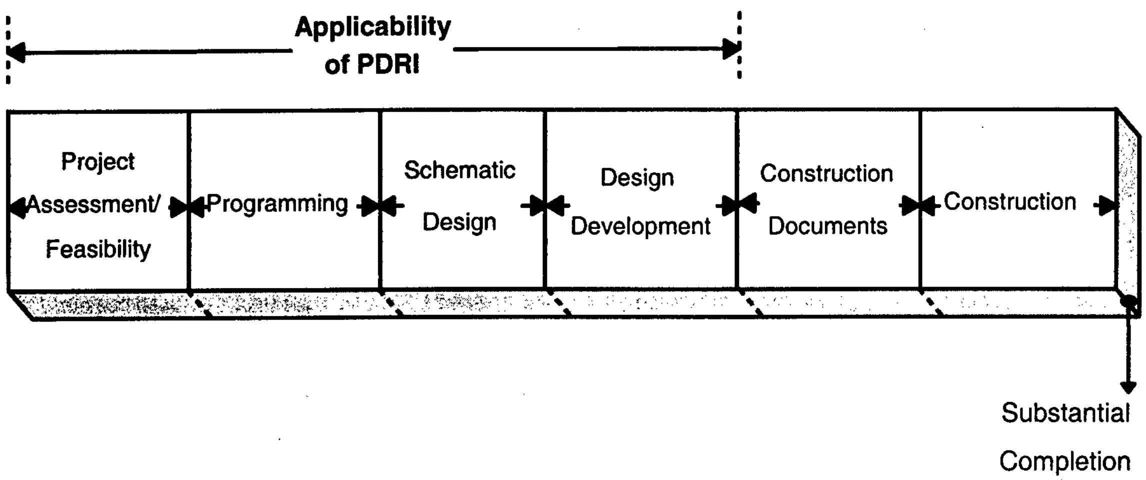

Figure 2.1: Applicability of PDRI in Project Lifecycle

The inner workings of the PDRI for Building Projects are very similar to the PDRI for Industrial Projects. The PDRI for Building Projects is composed of three sections that expand to 11 categories that further expand to 64 elements. These are shown in Figure 2.2 and completely detailed in Appendix D as part of the complete PDRI for Building Projects package.

SECTION I. BASIS OF PROJECT DECISION

A. Business Strategy
- A1. Building Use
- A2. Business Justification
- A3. Business Plan
- A4. Economic Analysis
- A5. Facility Requirements
- A6. Future Expansion/Alteration Considerations
- A7. Site Selection Considerations
- A8. Project Objectives Statement

B. Owner Philosophies
- B1. Reliability Philosophy
- B2. Maintenance Philosophy
- B3. Operating Philosophy
- B4. Design Philosophy

C. Project Requirements
- C1. Value-Analysis Process
- C2. Project Design Criteria
- C3. Evaluation of Existing Facilities
- C4. Scope of Work Overview
- C5. Project Schedule
- C6. Project Cost Estimate

SECTION II. BASIS OF DESIGN

D. Site Information
- D1. Site Layout
- D2. Site Surveys
- D3. Civil/Geotechnical Information
- D4. Governing Regulatory Requirements
- D5. Environmental Assessment
- D6. Utility Sources with Supply Conditions
- D7. Site Life Safety Considerations
- D8. Special Water and Waste Treatment Requirements

E. Building Programming
- E1. Program Statement
- E2. Building Summary Space List
- E3. Overall Adjacency Diagrams
- E4. Stacking Diagrams
- E5. Growth and Phased Development
- E6. Circulation and Open Space Requirements
- E7. Functional Relationship Diagrams/ Room by Room
- E8. Loading/Unloading/Storage Facilities Requirements
- E9. Transportation Requirements
- E10. Building Finishes
- E11. Room Data Sheets
- E12. Furnishings, Equipment, & Built-Ins
- E13. Window Treatment

F. Building/Project Design Parameters
- F1. Civil/Site Design
- F2. Architectural Design
- F3. Structural Design
- F4. Mechanical Design
- F5. Electrical Design
- F6. Building Life Safety Requirements
- F7. Constructability Analysis
- F8. Technological Sophistication

G. Equipment
- G1. Equipment List
- G2. Equipment Location Drawings
- G3. Equipment Utility Requirements

SECTION III. EXECUTION APPROACH

H. Procurement Strategy
- H1. Identify Long Lead/Critical Equipment and Materials
- H2. Procurement Procedures and Plans

J. Deliverables
- J1. CADD/Model Requirements
- J2. Documentation/Deliverables

K. Project Control
- K1. Project Quality Assurance and Control
- K2. Project Cost Control
- K3. Project Schedule Control
- K4. Risk Management
- K5. Safety Procedures

L. Project Execution Plan
- L1. Project Organization
- L2. Owner Approval Requirements
- L3. Project Delivery Method
- L4. Design/Construction Plan & Approach
- L5. Substantial Completion Requirements

Figure 2.2: PDRI for Buildings Sections, Categories, and Elements.

The research team realized that the 64 elements within the PDRI were not equally important with respect to their potential impact on overall project success. Therefore, it was apparent that each element needed to be weighted relative to one another to enhance the usefulness of the tool. In order to establish the relative

weights, the research team hosted seven weighting workshops, each lasting four hours. The workshops involved a total of 69 experienced project managers, architects, engineers with almost 1,500 total collective years of building project expertise to help evaluate and weight the PDRI elements. The weighting process was fairly complex and beyond the scope of this thesis. Suffice it to say that the raw weights obtained from these workshops were used to develop the final version of the PDRI score sheet by normalizing a scoring system of zero to 1000 points (the lower the score, the better the scope definition) (CII 1999c). At the end, an overall weighted score gives the user a score that corresponds to likelihood of project success.

The PDRI for Building Projects is completed in a similar manner to the PDRI for Industrial Projects (CII 1999c). Each of the applicable elements is scored by project participants according to the element definition level based on an analysis of its description. To illustrate the process for scoring a project, consider, for example, the need to evaluate how well the non-core equipment requirements have been identified and defined to date on a project involving the renovation of an existing office building. Major milestones have been identified throughout front end planning of this project at which the use of the PDRI to evaluate the current level of "completeness" of the scope definition package is intended. It can be assumed that at the time of this particular evaluation the scope development effort is underway, but it is not yet complete.

The non-core equipment information is covered in Category G, Equipment, of the PDRI as shown in Figure 2.3 and consists of three elements: "G1. Equipment List," "G2. Equipment Location Drawings," and "G3. Equipment Utility Requirements." Figure 2.3 shows a portion of the scoresheet that includes Category G, as well as a sample element description of Element G1. Although not included in this illustration, element descriptions for elements G2 and G3 can be found in Appendix D. Complete versions of the entire scoresheet and element descriptions are given in Appendix C and Appendix D respectively.

CATEGORY Element	Definition Level 0	1	2	3	4	5	Score
G. EQUIPMENT (Maximum Score = 36)							
G1. Equipment List	0	1	5	8	12	15	
G2. Equipment Location Drawings	0	1	3	5	8	10	
G3. Equipment Utility Requirements	0	1	4	6	9	11	
CATEGORY G TOTAL							

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

G. EQUIPMENT

G1. Equipment List

Project-specific equipment should be defined and listed. (Note: Building systems equipment is addressed in element F4, Mechanical Design, and F5, Electrical Design). In situations where owners are furnishing equipment, the equipment should be properly defined and purchased. The list should define items such as:

- ❑ Process
- ❑ Medical
- ❑ Food service/vending
- ❑ Trash disposal
- ❑ Distributed control systems
- ❑ Material handling
- ❑ Existing sources and characteristics of equipment
  - ❑ Relative sizes
  - ❑ Weights
  - ❑ Location
  - ❑ Capacities
  - ❑ Materials of construction
  - ❑ Insulation and painting requirements
  - ❑ Equipment related access
  - ❑ Vendor, model, and serial number once identified
- ❑ Equipment delivery time, if known
- ❑ Other

Figure 2.3: Sample of Scoresheet and Element Description

To following steps are carried out in the process of scoring a project.

Step 1: The description for each element is read. Some elements contain a list of items to be considered when evaluating their levels of definition. These lists may be used as checklists.

Step 2: The necessary evaluation data is collected. This may require obtaining input from other individuals involved in the scope development effort.

Step 3: The definition level for each element is selected. In this example, Element G1 is found to have some deficiencies (definition level 3), Element G2 has minor deficiencies (definition level 2) and Element G3 is incompletely or poorly defined (definition level 5).

Step 4: For each element, the score that corresponds to its level of definition is written in the "Score" column. If it is deemed that any or all of the elements are *not applicable* to the project they receive a definition level of "0".

Step 5: Element scores are added to obtain a category score. This process is repeated for each element in the PDRI. Section scores are added to obtain a total PDRI score.

Figure 2.4 shows the completed sample portion of the scoresheet. Category G has a total score of 22 (out of 36) indicating that it needs more work. Again, the lower the score, the better defined the project is.

CATEGORY Element	Definition Level 0	 1	 2	 3	 4	 5	Score
G. EQUIPMENT (Maximum Score = 36)							
G1. Equipment List	0	1	5	8	12	15	8
G2. Equipment Location Drawings	0	1	3	5	8	10	3
G3. Equipment Utility Requirements	0	1	4	6	9	11	11
CATEGORY G TOTAL							**22**

Definition Levels

0 = Not Applicable
1 = Complete Definition
2 = Minor Deficiencies
3 = Some Deficiencies
4 = Major Deficiencies
5 = Incomplete or Poor Definition

Figure 2.4: Completed Scoresheet Sample

In order to validate the usefulness of the PDRI for building projects, it was tested on actual projects to verify its viability as a tool. The primary goal of the validation process was to correlate PDRI scores with project measured in terms of cost performance, schedule performance, change orders, and customer satisfaction. To date the PDRI for Building Projects has been tested on a total of 33 projects varying in authorized cost from $0.8 million to $200 million (representing approximately $900 million). PDRI scores were computed for each of these projects and compared to project success criteria, such as cost and schedule performance. An analysis of these data yields a correlation between low (good) PDRI scores and higher project success. Further analysis has revealed a significant difference in performance between the projects scoring above 200 and the projects scoring below 200 prior to development of construction documents as

shown in Figure 2.5 (CII 1999c). The 'par score' of 200 was determined by the statistical analysis of the 33 completed projects.

Performance	**PDRI Score**		*Difference*
	< 200	**> 200**	
Cost	1 % above budget	6% above budget	5%
Schedule	2% behind schedule	12% behind schedule	10%
Change Orders	7% of budget	10% of budget	3%
	(N = 16)	(N = 17)	

Figure 2.5: Summary of Cost, Schedule, and Change Order Performance for the PDRI Validation Projects Using a 200 Point Cutoff

The validation projects scoring below 200 outperformed those scoring above 200 in three important design/construction outcome areas: cost performance, schedule performance, and the relative value of change orders compared to the authorized cost. In addition to cost and schedule differences, the projects scoring less than 200 performed better financially, had fewer numbers of change orders, had less turbulence related to design size changes during CD development and construction and were generally rated more successful on average than project scoring higher than 200 (CII 1999c).

The fact that the PDRI for Buildings is an industry created and industry validated pre-project planning tool dispenses with the need to generate a unique set of activities for the development of a NASA-specific PDRI. The PDRI for Buildings tool forms the basis for adaptation of the specific needs of NASA in developing the NASA-specific PDRI.

2.6 LITERATURE REVIEW

In addition to the review of pre-project planning publications from CII, a thorough literature review has been performed. The primary intent of this literature review was to gain insight into the NASA specific facility planning and budgetary cycles and to identify other endeavors aimed at customizing the CII PDRI to meet specific organizational needs. Excluding the CII publications, seven principle sources were found that were related to development of the NASA-specific PDRI. The following paragraphs describe the parts of each text that contributed to the development of this thesis.

The *Facility Project Implementation Handbook (FPIH),* NASA Handbook 8820.2A, provides a ready reference to pertinent policy and guidance for management of facility planning, budgeting, design, construction, environmental compliance and activation (NASA 1993). It covers the aspects of a facility project from the initial statement of the facility requirement to the commissioning and final facility activation. The provisions of the handbook are applicable to all NASA centers, Component Installations, and off-site facility locations. Chapter 1 of the FPIH provides an overview of the policy and guidance for Field Installations and to develop typical facility projects. Remaining chapters provide the detailed approach, methodology, and special considerations to review in order to plan, evaluate, design, and implement the projects. This document provided key insight into the NASA project programming process and when PDRI evaluations may ideally be conducted.

The following four NASA component level documents were reviewed: *Pre-Project Planning, Work Request*, Johnson Space Center Operating Instruction 7310.02 (NASA 1997); *Facility Systems Engineering Process*, LMS-CP-5620, Langley Research Center; *Generic P3 Process*, Goddard Space Flight Center; and *Long Range Facility Plan*, Lockheed Martin. These documents provided insight into the varied levels of pre-project planning guidance offered at different NASA centers.

A case study titled the *Outage Readiness Index (ORI)* was presented at the twentieth annual Construction Project Improvement (CPI) conference (CII 1999b). It details a successful adaptation of the CII PDRI into an Outage Readiness Index tool widely utilized by Tennessee Valley Authority (TVA). The ORI is the first tool of its kind in that it allows the outage management team to quantify, rate, and assess the level of outage readiness and preparedness at significant milestone intervals prior to the start of a scheduled outage. The ORI scores assessed at each milestone are plotted and compared to an expected progress graph. Modifications to the CII PDRI include: the reversal of the scoring scheme (high score is better), the customizing of the elements and weights, and the addition of completion dates and responsible parties for major action items. Insight was gained into the variables that drove ORI development and implementation success and the benefits realized by TVA.

A topic titled *Project Planning Equals Project Success* was also presented at the twentieth annual CPI conference (CII 1999f). A PDRI execution planning model used by BP Amoco to drive project definition readiness was presented. The

CII PDRI tool was applied without modifications at BP Amoco, and accomplished schedule and budgetary savings without the need for any customization.

The University of Texas thesis, *Logic Flow Diagrams for Planning of Building Projects* by Jeffrey Furman, details the development and validation of logic flow diagrams for the activities composing the pre-project planning process (Furman 1999). These diagrams lent assistance in the mapping of the pre-project planning elements described in the NASA Facility Project Implementation Handbook (FPIH) to those elements described in the CII PDRI. Figure 2.6 is presented to illustrate one of the developed diagrams outlining the general logic flow of the PDRI categories. The diagrammatic flow is not the traditional CPM logic paradigm in that the completion of certain elements is not required prior to the start of the subsequent elements. This particular logic flow diagram provided great assistance in the process of becoming acquainted with the sequencing logic behind the NASA pre-project planning methodology. The author used Furman's thesis extensively when outlining the chapters and sections of the NASA-specific PDRI development project.

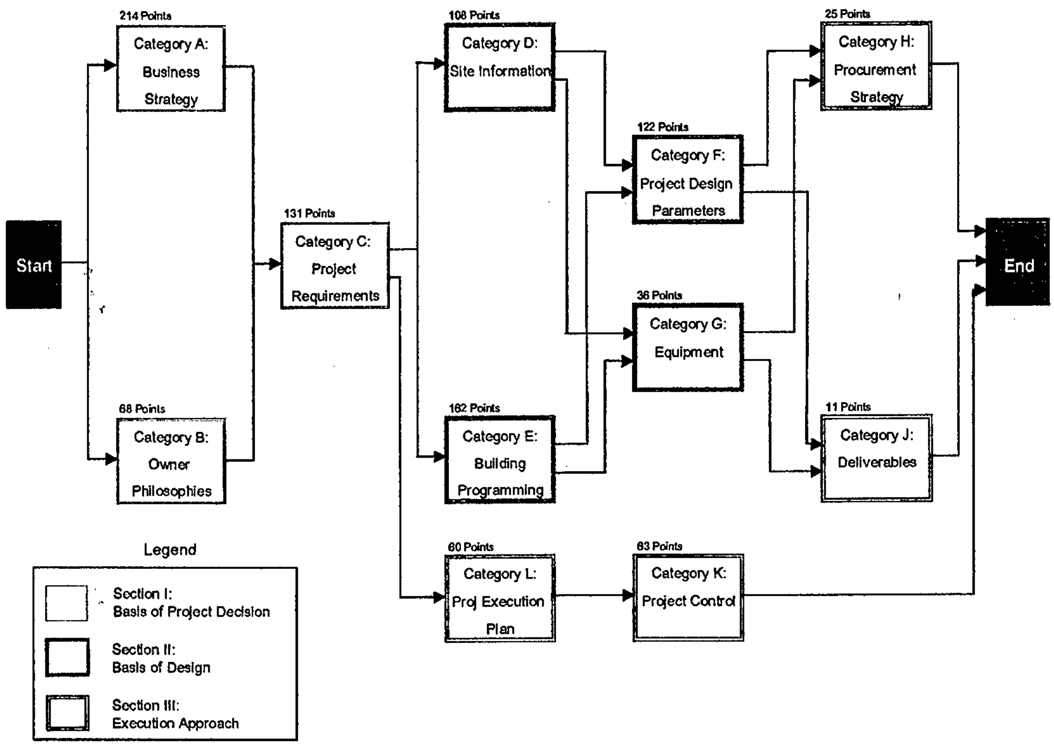

Figure 2.6: Category Logic Flow Diagram

2.7 SUMMARY

CII, NASA, and other public and private organizations have published numerous books and other literature relating to pre-project planning. However, there is not an abundance of documented instances of all-inclusive pre-project planning implementations to the extent outlined in the CII Pre-Project Planning Handbook, which include the integration and possible customization of the PDRI.

This is possibly due in part to the relatively recent development of the CII Pre-Project Planning Handbook and the PDRI tools. In addition, it is possible that a number of companies utilizing detailed pre-project planning documents and PDRI tools may view them as proprietary.

The NASA FPIH contains the majority of elements described in the CII Pre-Project Planning Handbook. Through a thorough review of the contents of the FPIH and related center planning documents, coupled with discussions with NASA planning experts, the prerequisites necessary to develop a NASA pre-project planning schedule including optimum points to conduct PDRI evaluations were revealed. The next chapter details the development of the NASA-specific PDRI.

Chapter 3: Research Methodology

3.1 INTRODUCTION

The NASA-specific PDRI development evolved as part of an ongoing effort to facilitate improved Pre-Project Planning at NASA. Following a request from NASA for agency-wide Pre-Project Planning assistance, a proposal was drafted and accepted in summer of 1999. The proposal occupied the services of the principal author and developer of the various CII Pre-Project Planning and PDRI publications, Dr. G. Edward Gibson, as well as the services of the author of this thesis. At NASA, a subgroup was formed titled the "P3 Team" composed of the principal facility planning experts from the various NASA centers. A listing of the fifteen P3 Team members is given in Appendix B. After some preparatory efforts, a two-day conference with the P3 Team was conducted at the Johnson Space Center in September 1999. It was at this meeting that the data necessary for the NASA-specific PDRI development were captured. In October 1999, a draft NASA-specific PDRI and Pre-Project Planning schedule were developed and circulated for feedback amongst the P3 Team members. In early November 1999, the NASA-specific PDRI was validated by assessment on an actual NASA facilities project. Validation feedback and P3 Team inputs were then incorporated into the final version.

3.2 DEVELOPMENT

On September 8, 1999, a meeting was held at the Johnson Space Center to define the general expectations, and the scope and agenda for the two-day Pre-Project Planning conference to be held later that month. The first two objectives of this thesis address the two primary expectations expressed; namely, the development of a NASA-specific Project Definition Rating Index (PDRI) tool and a schedule for the integration of the developed PDRI into the NASA Pre-Project Planning process. The agenda for the two-day conference was developed at this meeting. Appendix A lists the attendees and the minutes of this meeting.

Dr. Gibson and the author facilitated the Pre-Project Planning conference at the NASA Johnson Space Center on September 22 – 23, 1999. The conference started with facilitation leading the P3 Team to the establishment of their expectations, mission statement, and objectives. The conference then became a working session in which the data necessary for the development of the NASA-specific PDRI were established. The meeting minutes depicting the result of these efforts and list of attendees are found in Appendix B.

The PDRI for Building Projects (CII 1999e) was utilized as a template for the development of the NASA-specific PDRI. At the beginning of the working session, a data collection form was distributed to each of the P3 Team members. This form listed each of the elements found in the CII PDRI for Building projects tool along with space for the identification of each element's applicability to NASA revitalization projects and any specific NASA documents applicable to that element. The form also included space for the identification of additional

elements not already addressed by CII PDRI. A sample portion of the data collection form is illustrated in Figure 3.1.

B. BUSINESS OBJECTIVES	Appl.To Revital.	NASA Specs	Comments
B1. Products	Y / N	Y / N	
B2. Market Strategy	Y / N	Y / N	
B3. Project Strategy	Y / N	Y / N	
B4. Affordability/Feasibility	Y / N	Y / N	
B5. Capacities	Y / N	Y / N	
B6. Future Expansion Considerations	Y / N	Y / N	
B7. Expected Project Life Cycle	Y / N	Y / N	
B8. Social Issues	Y / N	Y / N	

Figure 3.1 Sample Portion of the PDRI Data Collection Form

The data collection process involved the rigorous scrutiny by the assembled panel of experts of each one of the elements and their corresponding element descriptions. The scrutiny was conducted sequentially on each of the 64 elements and their detailed descriptions and took approximately five hours. The session involved discussions on the element's relevance to NASA projects, the need for additions or deletions to the element descriptions due to NASA unique processes, the need for the identification of pertinent NASA forms and/or documentation, and the need for additional elements, categories and/or sections.

Following the working session, the data were consolidated for the construction of the NASA-specific PDRI. The draft NASA-specific PDRI was completed and distributed to P3 Team members on Oct 11, 1999. The updated PDRI was then sent to the P3 Team for comments, which were incorporated into the material in Appendix B.

Next on the conference agenda followed an explanation of the NASA Construction of Facilities (CoF) project cycle, which led to discussions on the identification of potential PDRI evaluation points along the project cycle. Several potential validation projects were also identified. A draft NASA CoF Project Cycle diagram was developed as a result of input from these discussions and was distributed for comments on October 21, 1999.

On November 1, 1999 a NASA-specific PDRI scoring session was conducted on a NASA project at Johnson Space Center. This scoring session was observed with the objective of validating the adequacy and completeness of the developed PDRI.

3.3 SUMMARY

The NASA-specific PDRI was developed as a collaborative effort between academia and a panel of NASA center planning experts. This process was important in the development of a useful tool directly applicable to the specific processes encountered at NASA. Expert knowledge was directly incorporated in to the development and validation of the NASA-specific PDRI. The next chapter highlights the changes necessary to develop the NASA-specific PDRI and the author's comments about its usage.

Chapter 4: NASA-Specific PDRI

4.1 Introduction

The NASA-specific PDRI was developed following the Pre-Project Planning Team conference. Appendix C contains the project scoring sheets that are used in conjunction with the developed PDRI. Appendix D contains the element descriptions of the developed NASA-specific PDRI. Some of the descriptions include checklists to clarify concepts and facilitate ideas when scoring each element. NASA-specific descriptions are annotated in bold text. Commentary referencing NASA-specific processes is placed in parenthesis.

4.2 Comparison to the CII Buildings PDRI

The CII Buildings PDRI was found to provide an excellent structure for the development of the NASA-specific PDRI. Even though each of the elements and their descriptions were meticulously scrutinized by the panel of experts, no additional or unwarranted elements were found. Every element contained in the CII Buildings PDRI was applicable to the NASA-specific PDRI. In effect, the total number of elements (64) remained the same.

Given the relevance of every element contained in the CII Buildings PDRI, the element weighting scheme developed by Research Team 155 which used the input provided by 35 owner and contractor organizations was found not to require adjusting. The weighting scheme found in Appendix C is the same as the one used in the CII Buildings PDRI.

The element descriptions were found to require numerous changes. In total, 68 changes were required to adapt the description to suit the needs of the NASA P3 Team. In general, the required changes commented on applications to NASA Forms, NASA documents other than forms, NASA or Government unique processes, and other processes such as safety. Table 4.1 summarizes the changes necessary to the element description in the NASA-specific PDRI development based on comments made at the development conference and additional comments received during the review period. The eleven categories listed in this table and their corresponding elements are detailed in Appendix C.

	Changes Required For...				
Category	NASA Forms	NASA Documents (Other than forms)	NASA/Govt Processes	Other	Category Total
A	3	2	3		8
B			3		3
C	3		4	2	9
D			6	6	12
E			11		11
F			5	2	7
G			2	1	3
H					0
I		2	4		6
J					0
K		2	1	4	7
L		1		1	2
Total	6	7	39	16	68

Table 4.1 Summary of Changes to Element Descriptions

4.3 USAGE

The P3 Team focused the NASA-specific PDRI development towards an application to building revitalization projects in the $500,000 to $1,500,000 range. Projects in this cost range are termed CoF minor revitalization or CoF minor

construction projects. Projects of costs less than $500,000 are considered "Center Funded" projects and as such, have a quicker approval cycle. Projects of costs greater than $1,5000,000 are termed CoF discrete projects.

After undergoing the PDRI development process, it was noted by the P3 team that the developed PDRI could certainly apply to a wider range of projects than originally envisioned. Projects in the "Center Funded" cost range for example, could also benefit from a "checklist" approach to the PDRI for determining the necessary steps to follow in defining the project scope. A scaled down version of the NASA-specific PDRI may be a practical approach for center-funded projects as the carrying out of the complete PDRI may be too costly for this category of projects. CoF discrete projects could also greatly benefit from PDRI evaluations. All, in all, the NASA-specific PDRI was determined to apply to new construction and revitalization projects of all cost ranges. New construction or revitalization projects, whose efforts greatly involve industrial processes, would instead require the use of the CII Industrial PDRI.

4.4 VALIDATION

As the CII Buildings PDRI was not specifically designed for the renovation or revitalization projects, its use to assess the project definition of a University of Texas Dining Commons renovation project was observed to note its relevance to renovation projects. This was the first known use of the Building PDRI on a renovation project. Appendix E documents the observations made during the scoring session. In general, all the element descriptions were found to be useful for renovation projects and require no major modifications. It appeared

that in the initial stages of scoring, participants did not bear in mind the full basis of each of the elements being evaluated and that the overriding concern was getting a "good grade" rather than identifying areas warranting further attention. As the scoring process progressed, some large areas of non-definition were discovered, creating a heightened sense of the value of the PDRI and closer attention to the details of each element. This awareness stimulated many follow-on discussions. Four elements (A7, D2, D3, F1) were found to be not applicable to the project. They involve site definition aspects that could in reality be applicable to other renovation projects. The CII Buildings PDRI was noted to be appropriate for renovation projects as well as new construction.

A second scoring session was evaluated in order to validate the use of the NASA-specific PDRI on an actual NASA project. On November 1, 1999, the evaluation of the project planning efforts of a partially designed 11,300 SF, $1.2 MM Child Development Center (CDC) was conducted in Johnson Space Center. This was the first time that the newly developed NASA-specific PDRI was used to assess the planning of a NASA project. The scoring of the PDRI was facilitated by Dr. Gibson, Mr. Todd Graham, and by the author and was carried out by representatives from: NASA project management, NASA contracting, NASA estimating and design, customer, general contractor, safety consultants, and operations and maintenance consultants (20 personnel in total). Appendix G contains the minutes highlighting key observations made during the scoring session. In general, the NASA-specific PDRI was found to capably address the planning definition assessment needs of this actual NASA project. The

modifications and NASA-specific comments were found to be helpful and relevant. The project team members voiced many encouraging comments confirming the effectiveness and value of the developed PDRI. The use of the NASA-specific PDRI highlighted poorly defined areas, determined the project's major risk issues, provided a constructive exchange of ideas, and promoted alignment between the customer, the project team, and the contractor. An action list was generated as a derivative of the scoring process, which was easily priority ranked by relative risk by simply summing up the related elements' scores. Appendix G contains the derived action item list. The NASA-specific PDRI was successful in identifying the risk areas and in promoting team communications.

4.5 Summary

The CII Buildings PDRI was found to provide an excellent structure for the development of the NASA-specific PDRI. Even though the elements for the PDRI for buildings were developed with the construction of a new facility (and not the renovation of an existing one) in mind, all the element descriptions were found to be common and broad enough by the P3 Team to be useful for renovation projects in their current state. A total of 68 changes in the element descriptions were found necessary to develop the NASA-specific PDRI. The NASA-specific PDRI was established to be suitable for new construction and revitalization projects (not encompassing extensive industrial processes), of all cost ranges. The following chapter describes the development of the recommended points in time within the Pre-Project Planning timeline at which the NASA-specific PDRI is recommended for use.

Chapter 5: Pre-Project Planning at NASA

5.1 INTRODUCTION

As a second objective to this thesis, a NASA-specific pre-project planning timeline was to be developed. It was also desired to include in the timeline, optimal points in time for the utilization of the NASA-specific PDRI tool. To accomplish this objective, an understanding of the major milestones and sequences of the NASA facility planning project cycle was necessary as outlined below.

5.2 BACKGROUND

The NASA Construction of Facilities project cycle operates on a 5-year plan. This plan, and all its elements, are explicitly defined in the FPIH (NASA 1993). The 5-year planning process includes the identification of functional requirements that need to be satisfied to achieve mission objectives and the conversion of these requirements into facilities and equipment resources. This effort is a continuous updating process based on improved data from the progressive pre-project planning efforts.

Figure 5.1 illustrates the major events in a typical NASA project cycle as discussed by the NASA Pre-Project Planning Team meeting of Sep 23, 1999. The major project events are placed in a time sequence relative to the 'budget year," or the year in which funds are expected to be made available for the execution of the proposed project. For illustration purposes, a timeline referencing the budget year

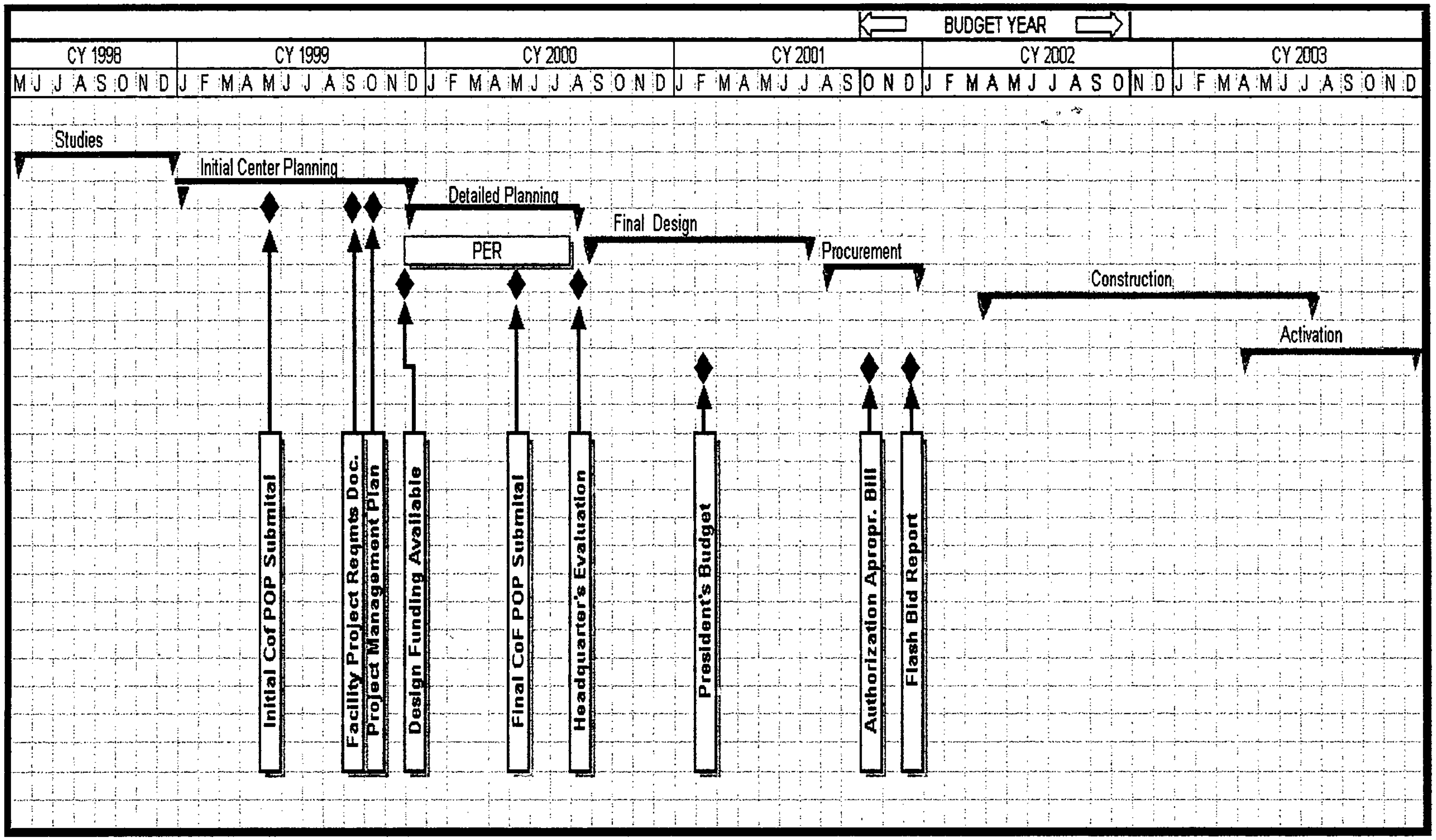

Figure 5.1 Typical NASA Construction of Facilities (CoF) Project Cycle

2002 was inserted. This budget year is the one for which NASA centers have recently submitted Project Requirements Documents (described later). The events in the project cycle are planned around the congressional appropriations cycle.

5.3 PRE-PROJECT PLANNING TIMELINE DEVELOPMENT

Once the general sequence and timing of the milestones in the NASA project cycle were understood, the placing of pre-project planning events relative to the project milestones was undertaken. This was accomplished through an interactive process during the NASA P3 Team conference in Sept 23, 1999. The NASA planning experts agreed that the general pre-project planning timeline illustrated in Figure 5.1 would provide a sound process. A draft of this diagram was originally sent out the P3 Team for comments, which were incorporated into the final validated version.

Figure 5.2 further breaks down the NASA pre-project planning steps. This illustration follows the same time line as Figure 5.1 and is also referenced to a Budget Year of 2002. The major elements of this figure are explained in the FPIH (NASA 1993). The FPIH requires the submittal of various documents, which detail the execution of critical planning steps. The sequencing of the NASA elements were found to coincide fairly well with the sequencing of the major CII Buildings PDRI categories outlined in the Logic Flow Diagrams contained in the thesis by (Furman 1999). The elements of Figure 5.2 are described in the following paragraphs.

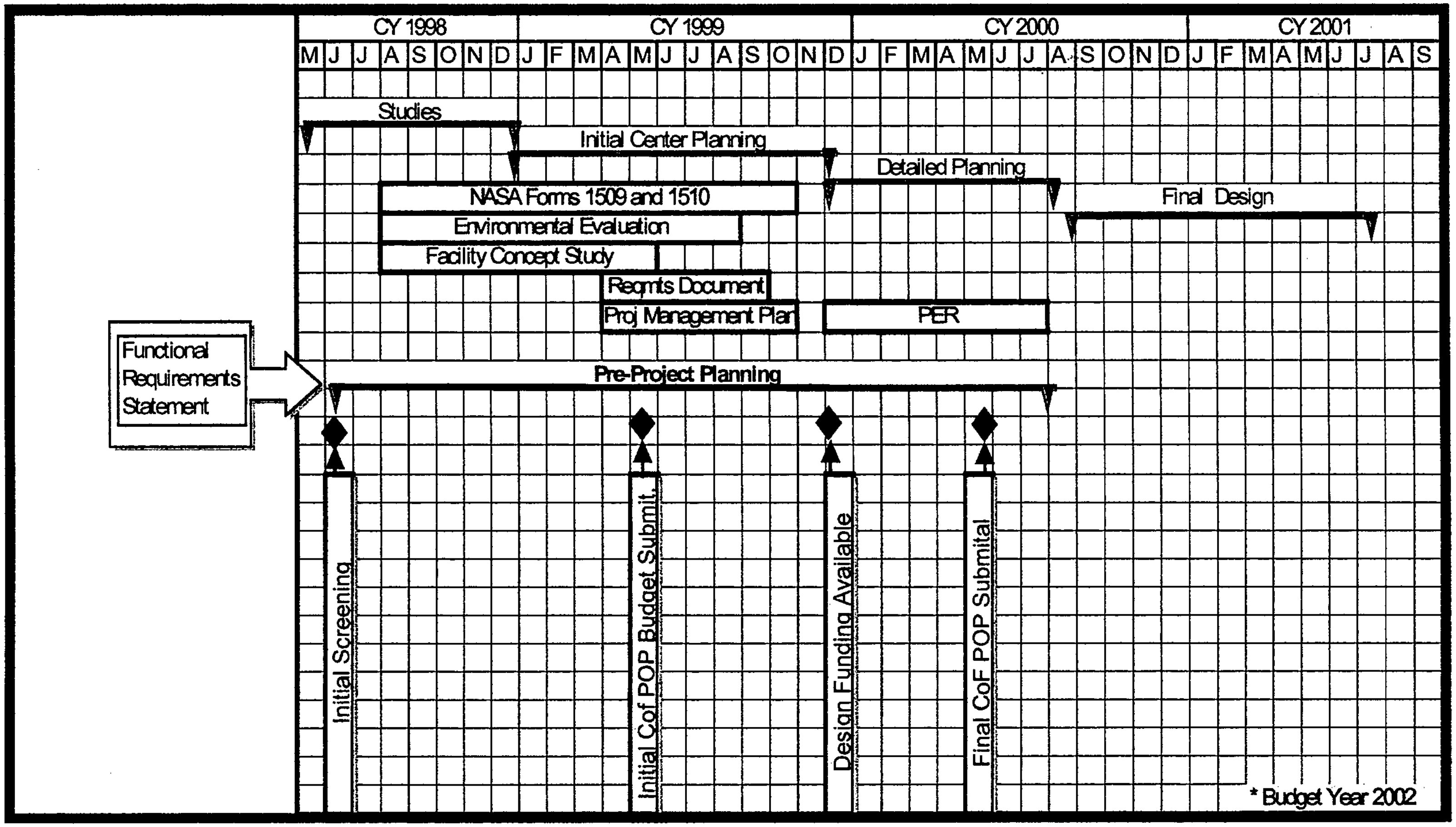

Figure 5.2: NASA Pre-Project Planning Time Line

The identification and validation of functional requirements is the first step. This is accomplished through the completion of a Functional Requirements Statement. This statement defines the type of capability that is needed and evaluates various options that meet the stated need. The primary use of this statement is to support the center's decision-making process, which leads to the inclusion of the proposed project in the 5-year plan. In some cases, funds may be available from NASA Headquarters or from center programs to perform this work.

The initial project screening at the center level occurs next. This screening reveals those projects that warrant future pre-project planning efforts from the center perspective. This process allows the center to "cull" projects that have little chance of funding or that fail to meet the center's mission. This screening in turn, allows the center to conserve resources and focus planning efforts. Actual screening procedures vary by center. An effective ranking approach to the screening process utilized by one of the NASA centers is included in Appendix F.

Following a favorable decision at the screening process, a series of pre-project planning steps begin concurrently.

- Brief Project Document (NASA Form 1509). This form should fully explain the proposed facility project including an accurate and concise description, scope and justification of need, and full disclosure of related resources. When approved, this form authorizes and directs implementation of the facility project described, contingent on funds being made available.

- Facility Project Cost Estimate (NASA form 1510). This form is a cost summary page for all cost estimate packages developed for facility projects. It includes a breakdown of total project costs into major cost elements.
- Facility Concept Study. The basic elements of the concept study are an updated discussion of the mission, operations, or research and development tasks that generated the requirement for a new or modified facility, and an expanded description of the proposed facility. Included in the study are; evaluation of options, site description, structural, mechanical, electrical, energy and environmental considerations, fire protection, life safety, and schedule sensitivity.

The information necessary for the completion of the three previously mentioned documents is also relevant to the Project Requirements Document. Again, project-specific funding may be available to perform this work through requests from NASA Headquarters or from the supported program. The project Requirements Document is essentially an update and expansion of the Facility Concept Study with major emphasis on the project description. The Requirements Document is considered the most important pre-project deliverable, as it is the primary input to the Preliminary Engineering Report (PER). In parallel with the development of the Requirements Document, the facility Project Management Plan is also prepared. This plan establishes a realistic schedule for the implementation of a facility project and assigns responsibility and authority for various actions. The plan is approved prior to the start of the final design work.

Approximately ten percent of the CoF Program Operating Plan (POP) budget estimate is made available to the centers for project designs during the month of December after the initial POP submittal. The final pre-project planning step, the Preliminary Engineering Report (PER), is commenced following the availability of design funding. The PER is the link between the budget concept requirements definition and the final design. A well developed PER is essential to validate a project cost by providing an engineering cost basis. PER requirements vary from center to center. Some centers are no longer performing the PER; however, the PER planning elements are still carried out. The scope of the PER includes preliminary engineering studies, the analysis of alternatives, essential design requirements, schematic single-line drawings, siting information, specification outline, and cost estimates. The completion of the PER is also considered the 35% project design completion point.

5.4 PDRI Applied to the Pre-Project Planning Timeline

Following the analysis and understanding of the NASA pre-project planning events relative to the budget cycle, specific points at which to conduct NASA-specific PDRI evaluations are recommended. Three proposed evaluation points within the period of the pre-project planning cycle are identified in Figure 5.3. As with Figures 5.1 and 5.2, this illustration is also referenced to a Budget Year of 2002. PDRI evaluations conducted at each of the recommended points offer a series of distinct benefits to the overall pre-project planning process. The rationale behind their selection is explained in the following paragraphs.

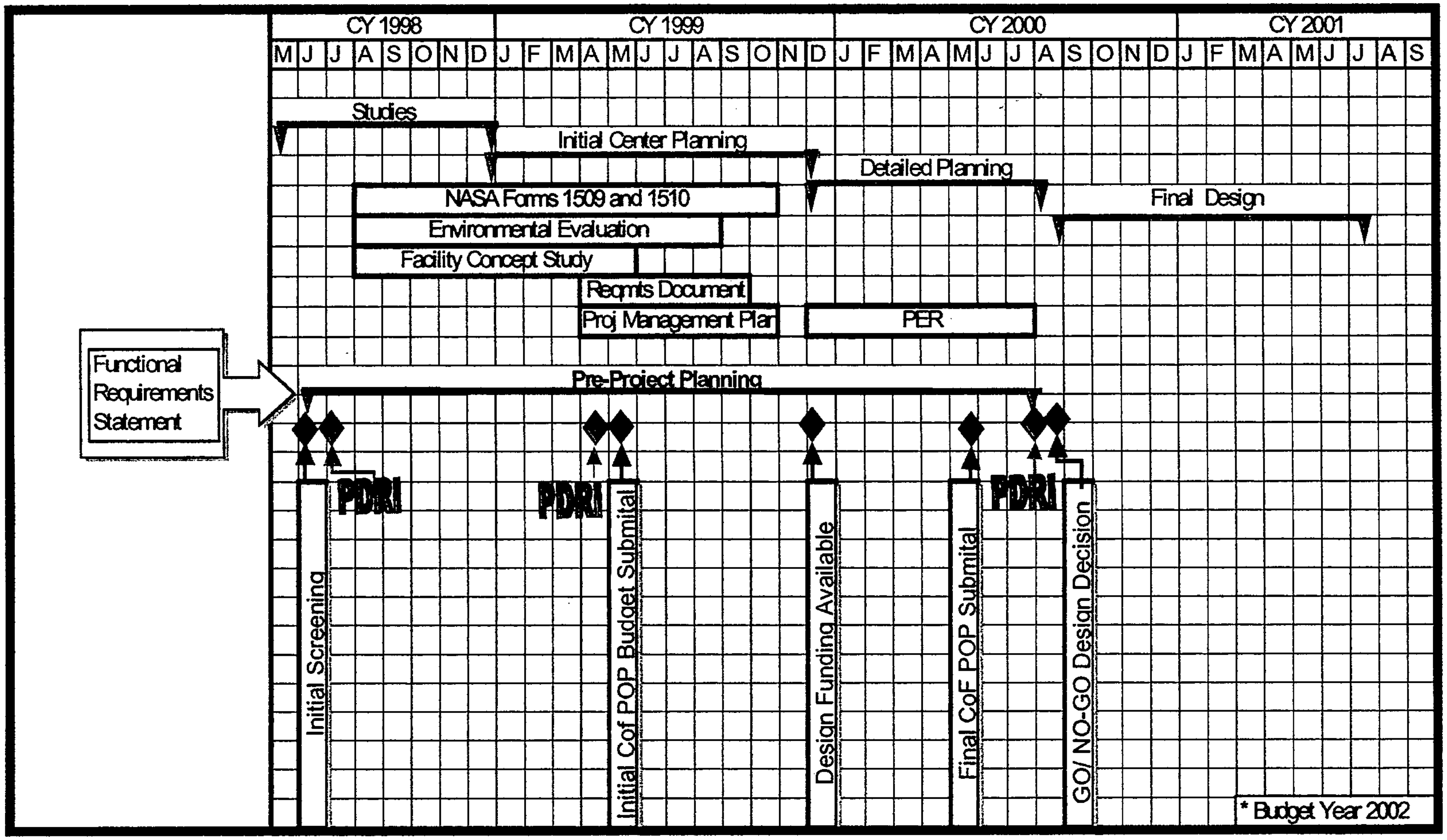

Figure 5.3: NASA Pre-Project Planning Time Line with PDRI Evaluation Points

The first NASA-specific PDRI evaluation is recommended at the completion of the initial screening process. At this initial stage in planning, the PDRI score in itself will serve little purpose except to show areas that need work. However, the PDRI can be valuable to the planning team (or individual) if used at this point in time as a checklist to point to all the items requiring consideration. Action items and due dates based on the checklist approach can be assigned. The process of identifying and defining the elements contained in the NASA specific PDRI provides an excellent starting point for the completion of the documents leading to the Project Management Plan.

It is at the completion of the Facility Concept Study and prior to the initial Program Operating Plan (POP) budget submittal that the second NASA-specific PDRI evaluation is recommended. This point occurs approximately one year after the initial PDRI checklist evaluation. At this point, a sense for the adequacy of the project estimate can be developed and appropriate adjustments be made prior to the submission of the initial POP budget. In addition, planning team members can rate the completeness of the project scope definition at this point and redirect efforts to correct the inadequately defined areas prior to the Project Requirements Document submittal and the commencement of the Preliminary Engineering Report (PER). By adding the poorly defined PDRI element scores, the planning team can also see how much risk these elements bring to the project relative to the maximum score. This provides an effective method of risk analysis since each element, category, and section is weighted relative to each other in terms of potential risk exposure. Through remedying inadequately defined areas identified

by the PDRI evaluation, a basis is formed for the realization of an accurate and complete Requirements Document.

It is at the completion of the PER that the third and final NASA-specific PDRI evaluation is recommended. The evaluation of the completeness of project scope definition at this critical point in time can form the basis for a decision to proceed with final design or to hold off on the project due to the excessive risks involved. The PDRI may also be used as a "bridging" tool at the initiation of the detailed design to communicate NASA's intent to the project design team. It is advisable to use caution when beginning the final design of projects with a PDRI score greater than 200 since a direct correlation exists between high PDRI scores and poor project performance.

5.5 POTENTIAL FOR RELEVANCE TO OTHER GOVERNMENT AGENCIES

The development of the NASA-specific PDRI and its application to the NASA pre-project planning timeline demonstrates the potential for a successful adaptation of CII pre-project planning practices and tools at a government agency level. The NASA capital facility financing process outlined in this chapter stems from congressionally mandated acquisition regulations, and as such, is analogous to those processes utilized at other government agencies such as the Department of Defense. While it is beyond the scope of this thesis to describe the project cycle processes utilized by the various governmental agencies, suffice it to say that they go through common phases that are carried out within a mandated congressional appropriations cycle. These common phases consist of:

- A planning phase where global requirements are assessed and defined.
- A programming phase, which matches the requirements with the strategic plans and translates them into a structure program.
- A budgeting phase, which expresses the structure program in terms of appropriation requirements.

As in the case of the NASA project cycle, the three phases are closely interrelated with the "planning" and "programming" timed to conform to the more rigid congressional budget cycle.

The commonality between the inter-agency capital facility financing processes present a positive prospect for similar adaptations of the CII pre-project planning practices and tools at other government agencies.

5.6 SUMMARY

In accordance with the objectives, a NASA-specific pre-project planning timeline including optimal points in time for the utilization of the NASA-specific PDRI tool was developed. The developed timeline offers a standardized methodology that can be embedded and institutionalized agency wide. The timeline was developed through researching the FPIH and through input received at the P3 Team conference. The timeline was validated through the utilization of feedback requested of the P3 Team. The following chapter presents thesis conclusions and recommendations including thoughts on the use and further development of NASA-specific pre-project planning tools.

Chapter 6: Conclusions and Recommendations

6.1 Conclusions

The primary objective of this thesis was to develop a NASA-specific Project Definition Rating Index (PDRI) tool. As a part of this objective, an examination of the capability for adaptation of the CII Buildings PDRI for use on revitalization projects was conducted. The CII Buildings PDRI was found to be versatile and adaptable for use on revitalization projects. The developed NASA-specific PDRI is a useful in-process tool that can be utilized by NASA planning teams several times during the pre-project planning process. This developed tool was determined to be valid for all NASA new construction and revitalization projects of all cost ranges.

A standardized process for the implementation of PDRI evaluations within NASA's budgetary programming guidelines was identified in the accomplishment of the second objective. The NASA-specific PDRI provides wide-ranging benefits when utilized at the recommend process points. Some of the benefits include:

- A checklist that the project team can use for determining the steps to follow in defining the project scope and in accurately completing the required NASA planning documents.
- A means to monitor progress at various stages during the planning process. Initial POP estimates can be appropriately adjusted to reflect the degree of scope definition at budget submittal.

- A tool that aids in communication and promotes alignment between planning operations and the detailed design personnel.
- A means of standardizing scope definition terminology throughout the agency.

The majority of the CII Pre-Project Planning elements were found to be comprehensively described in the FPIH. Although the FPIH contained a wealth of useful material, it may be confusing when employed as a user's manual because the material is not presented in a format conducive to practical day-by-day referencing.

The initial screening phase was found to be an essential beginning to the pre-project planning process as it allows the center to conserve resources and focus planning efforts to the projects that are most defensible. An example screening process is contained in Appendix F.

The CII PDRI for Buildings and the developed NASA-specific PDRI were used in on-going project planning sessions during design development to observe and validate their efficacy in helping teams complete project planning activities. Two projects, a large-scale dining commons renovation and a $1.2 million child development center project, were used in this analysis. In each case, the PDRI gave project team members a viable platform to discuss project specific issues and helped identify critical planning problems. Furthermore, the use of the developed NASA-specific PDRI highlighted poorly defined areas, determined the project's major risk issues, provided a constructive exchange of ideas, and promoted alignment between the customer, the project team, and the contractor.

CII pre-project planning practices and tools can be successfully adapted to a government agency level. The commonality between the inter-agency capital facility financing processes present a positive prospect for similar adaptations of the CII pre-project planning practices and tools at other government agencies.

6.2 RECOMMENDATIONS

In an effort to fully implement a standardized NASA-wide pre-project planning process, it is recommended that the FPIH be revised such that it can be effortlessly employed as a user's guide rather than a burdensome requirements document. Items worthy of consideration by the FPIH revision team are:

- Incorporate feedback from the NASA P3 Team.
- Add projected Pre-Project Planning timelines with PDRI evaluation points similar to those illustrated in Figure 5.3.
- Include team building and team alignment opportunities as a fundamental part of the pre-project planning process.
- Standardize and communicate the methodology for the procurement of resources for the planning efforts starting at the initial screening and ending with the PER.
- Emphasize and standardize an "Objectives Matrix" approach to the initial screening process. Individual criteria weights may vary by center; however, a standard ranking matrix such as the one contained in Appendix F, can be extremely beneficial in the dissemination of center objectives.

In addition, it is recommended that other governmental agencies such as NAVFAC strongly consider the adaptation of CII Best Practices such as the PDRI for Buildings and Industrial Projects. The adaptation of the PDRI for Buildings and Industrial projects can be performed first at a pilot location following similar steps to those outlined in this thesis.

Appendix A: Meeting Minutes 8 Sep 99

NASA Johnson Space Center, Bldg 45, Houston, TX
September 8, 1999

Attendees:

Name	Organization	Phone#
Steve Campbell	NASA/JSC/JA161	(281) 483-3200
Bob Kehoe	NASA/JSC/JA15	(281) 483-3149
Kenneth Heussner	NASA/JSC/JJ13	(281) 244-5809
Edd Gibson	UT Assoc Prof	(512) 471-4522
Ben Barrow	UT Grad Student	(512) 892-7228

The purpose of the meeting centered around the definition of the scope and agenda for the September 22 –23rd Pre-Project Planning and Project Definition conference to be held at NASA JSC Building 12. A draft agenda (enclosure 1) was presented and found to be acceptable. The following modifications/comments were noted:

- Add a "Welcome to the Conference" item conducted at the opening by Bill Parsons and Steve Campbell. Duration: 15 mins.
- PDRI Success Stories will be incorporated in the presentation.
- Time durations will be changed to actual time periods (e.g. 0800 – 0900) to include breaks and lunch periods.
- Agenda items will include more details particularly for those desiring to prepare for the conference.
- The 22nd would be scheduled for a full 8-hour conference day and the 23rd for a follow-on 4-hour session.
- The nearby cafeteria would be suitable for a convenient 1-hour lunch break on the first day.
- All deliverables are to be provided in an electronic media format.
- The local JSC staff will make coffee available during breaks; the UT staff will provide donuts.
- Approximately 15 attendees representing each of the NASA centers are expected. 17 copies of PDRI handbooks will be mailed to Steve Campbell.

General expectations for the P3 consulting efforts were discussed and generally fell in two major categories: Assistance in the definition of a P3 culture that integrates the PDRI in the planning process and the development of NASA specific PDRI planning tools. More specific expectations will be obtained from the conference attendees at the beginning of the conference. Discussions relevant to these topics were:

- 4-5 Workshops would be scheduled to address the first major category. The workshops would be aimed at process implementation with team building and team alignment as key focus areas. "PDRI facilitators" would

be trained to take the processes back to their centers to ensure they are executed and done so in a consistent manner. In addition, "PDRI facilitators" would initiate post PDRI evaluation follow-up actions.

- The standardization of the P3 process to include the points in time at which PDRI evaluations are to be executed was tabled as a long-term objective for the P3 team and to be possibly included in an update to the FPIH.
- The NASA Facility Project Budgeting process was identified as a sizeable issue to be contended with in the establishment of the P3 process. Ideas for funding sources for front-end planning efforts as well as expectation for in-house efforts were explored.
- The second major category zeroed in on the need for the development of two NASA specific PDRIs for projects falling into the grouping of Building Revitalizations and Electro-mechanical Revitalizations. The PDRIs are to primarily address project cost range of \$0.5M – \$1.5M.

The methodology for the development of the desired PDRIs for Building revitalization and for Electro-mechanical revitalization projects was discussed. The element comment sheets to be utilized at the conference in obtaining feedback on the applicability of PDRI elements to NASA specific projects were presented. (Enclosure 2 & 3). The methodology for the modification of element descriptions was also discussed. Discussions relevant to this topic were:

- One of the conference's objectives is to obtain sufficient feedback to define a NASA specific PDRI for <u>both</u> of the revitalization project types. If faced with time constraints, priority will be given to the Electro-mechanical revitalization PDRI.
- It is anticipated that PDRI for Buildings (in its original form) will be suitable for minor construction projects and many other project types not falling into the specific revitalization categories to be addressed.
- Changes in the number of elements to be evaluated will necessitate the establishment of a new target PDRI score for NASA projects. Several suggestions at arriving at an estimated target score were discussed. It is anticipated that the P3 team will be further refining a target score over time through empirical methods.

The need for PDRI validation on actual NASA projects was discussed. A Bio-medical facility project was identified as a possible candidate for a November-December time frame. Other PDRI validation candidates are expected to be identified during the conference.

Appendix B: Meeting Minutes 22 Sep 99

PPP Team Meeting
September 22-23, 1999

1. The meeting got started at 8 am and followed the agenda (Attachment A); Attendees of the meeting are given in Attachment B.

2. The meeting proceeded with introductions, review of the (Gibson's) proposal tasks and then brainstorming a list of expectations of the participants and expected deliverables as outlined below.

EXPECTATIONS

- Use P3 as a routine tool
- (3) Learn about P3 tools
- Take enthusiasm back to centers about P3
- (4) Formalize P3 for all projects with FPIH and Budget cycle policy.
- (2)Resource commitment for P3
- Help with educating management
- More consistent approach to planning
- (2)Tools to help do P3 better (given limited time and vast number of projects)
- (2) Help link master planning to P3
- (2) Formalized tools
- Appropriate process(correctly utilized for budgeting)
- Refined tools for NASA
- Better integration of Enterprise and Program Planning with Facility Planning.
- Better integration with safety, maintenance and operations,...etc. in P3.

DELIVERABLES

- FPIH revision guidance or input
- CoF course (added to parking lot)
- NASA specific PDRI(s)
- Input on NASA process and implementation of tools
- Measurement approach.
- Final Report.
- PDRI facilitator course

3. The meeting continued with development of P3 Team mission and objectives as given below. This process was performed by brainstorming critical phrases and issues as given in the rollup list below the mission and objectives.

P3 TEAM MISSION STATEMENT

Enhance NASA's facilities program by developing a proactive and flexible P3 process to establish and validate customer expectations. Improve and standardize the use of effective tools and proven techniques to achieve quality, schedule/cost effectiveness and efficient use of resources to satisfy Program/Institutional requirements.

P3 TEAM OBJECTIVES

1. Integrate our efforts with Master/Strategic planning and capital budget cycle.
2. Efforts encompass all sizes/types of facility projects.
3. Define process to incorporate tools and techniques.
4. Consider implications and best practices in our efforts.
5. Address resource requirements to support planning.
6. Embed and institutionalize our efforts and capture lessons learned and industry trends.
7. Develop NASA specific (center adaptable) tools.
8. Develop metrics approach to our efforts.

MISSION STATEMENT DEVELOPMENT

WHATs

- √ Standardize Processes
- √ Tools
- √ Implementation
- Proactive Program
- Creating Focus
- Sanity check
- Increased Planning Horizon
- Comfort level
- Accurate estimates
- √ Proven Techniques
- Properly defined requirements up front (Program & Project)
- √ Flexibility w/o compromising quality
- Real understanding of process
- √ Support HQ needs (comfort level)
- Master/Strategic planning

HOWs/WHOs

- √ Cost Effective
- √ Timely Manner
- Customer Satisfaction
- √ Efficient use of Resources
- Mission Requirements
- Owner Buy-in
- √ Internal Customers
- √ External Customers
- Efficiency
- Lessons learned
- Metrics
- √ Scalable
- Quality Product

4. The meeting continued with Dr. Gibson giving a comprehensive overview of the P3 process and tools as developed by CII. His powerpoint presentation will be sent via e-mail separately.

5. The session then became a working session in which the team went through the PDRI for Buildings --element by element-- to check for validity with NASA processes and also if it could be used for revitalization products. Some of the element descriptions were modified slightly to encompass NASA specific procedures, problems and forms. Dr. Gibson and Ben Barrow will send this modified version to the team within three weeks of the meeting for review. The overall conclusion of this analysis was that the CII PDRI for Buildings is flexible enough to work for NASA projects from $500k and above, revitalization and green field (and probably below $500k as well). The enhanced PDRI will be tried on four projects this fall as outlined in the action list. Dr. Gibson will evaluate the CII PDRI for Industrial Projects using the same criteria that were used in this session to determine its applicability to NASA specific "industrial" projects.

6. The CoF process was reviewed and discussed in some detail. It was agreed that Dr. Gibson and Ben Barrow will incorporate the results of the discussion and comments into a modified timeline for review by the team. This timeline will show traditional NASA FPIH planning tasks such as concept study, requirements documents and PER in relation to the POP submittal and overlay where the PDRI is recommended to be

used. Screening of projects prior to detailed planning was discussed as an important part of the process to reduce wasting of resources. Terry volunteered to send her (GSFCs) screening process to the team for review. Tam agreed to send his planning team guidance materials to the team for review.

This development effort will be part of the process suggestions offered by the team. Dr. Gibson will continue to work on this effort as part of task 1 of the consulting agreement.

7. The following actions were discussed and assigned.

ACTIONS

Item	Responsibility	Due
1. Try PDRI on minor renovation projects (2 @ JSC) and report results	Campbell, Barrow Gibson	Oct 31
2. Try PDRI on minor Lab and Office projects and report results	Terry Spagnuolo	Oct 31
3. Try PDRI on Revitalization Project Development if possible and report lessons	All	Dec 99
4. Priority Screening Matrix to P3 team electronically	Terry Spagnuolo	Oct 7
5. "Team Guidance" instructions to P3 team	Tam Antoine	Oct 7
6. Document P3 process map	Barrow/Gibson	Oct 31
7. Modified PDRI sent to P3 Team	Barrow/Gibson	Oct 12
8. PDRI end product examples sent to team	G.R. Rupnarain	Oct 7

8. Several items were put in the "parking lot" for future consideration:

PARKING LOT

- NASA taught and developed CoF best practices course (2-3 hrs modular training) (Feb at Wallops)
- Lessons learned development and deployment. P3 facilitators to keep track of project scoring metrics.
- Lessons learned on P3 team process
- POP process explanation
- Ranking of processes currently in use
- P3 process for Design/Build and Fast Track projects

9. It was agreed that much of the team's work can be conducted via e-mail and VITS conferences. The team will probably need to get together again in 1Q00. Dr. Gibson will continue to work on tasks as outlined in his consulting agreement in the interim--in concert with Steve Campbell at JSC.

Attachment A

Agenda

September 22-23, 1999
JSC Houston, TX

Wednesday, September 22, 1999

Item:	Facilitator	Times
1. Welcome	Parsons, Campbell	8:00 – 8:15 am
2. Introductions and Expectations of P3 Team participants	Gibson	8:15 – 9:15 am
Coffee Break	All	9:15-9:30 am
3. P3 Team Mission and Objective Setting	Gibson	9:30 – 10:30 am
4. Schedule and Deliverables Discussion	Gibson	10:30 – 11:30 am
Lunch	Cafeteria	11:30 – 12:30 pm
5. Overview of CII Research	Gibson	12:30 – 1:30 pm
6. Development of Revitalization PDRIs for Building and Electrical/Mechanical Projects Workshop	Gibson/Barrow	1:30-2:30 pm
Coffee Break	All	2:30 – 2:45 pm
6. Development Workshop (Cont'd)	Gibson/Barrow	2:45 – 5:00 pm

Thursday, September 23, 1999

Item:	Facilitator	Times
6. Development Workshop (Cont'd)	Gibson/Barrow	7:30 – 9:00 am
Coffee Break	All	9:00 – 9:15 am
6. Development Workshop (Cont'd)	Gibson/Barrow	9:15 – 9:45 am
7. Discuss Path Forward/Validation	Gibson	9:45 – 10:10 am
8. Action Item Review/Next Meeting/Logistics	Gibson	10:10 – 10:30 am

Attachment B

	PPP Team Meeting Attendees			
	September 22 -23, 1999 JSC, Houston, TX			
	Name	Org Code	Phone number	E-mail
1	Bela Gutman	JPL	(818) 354-7406	bela.t.gutman@jpl.nasa.gov
2	Ernest Jennings	ARC	(650) 604-6023	ejennings@mail.arc.nasa.gov
3	Mark Warren	SSC	(228) 688-3388	mark.warren@ssc.nasa.gov
4	Roz McCreery	LARC	(757) 864-6940	r.l.mccreery@larc.nasa.gov
5	Terry Spagnuolo	GSFC	(301) 286-2769	tspagnuo@pop200.gsfc.nasa.gov
6	Lou Desalvo	KSC	(407) 867-3035	louis.desalvo.1@ksc.nasa.gov
7	Chris Wolf	WSTF	(505) 524-5152	cwolf@wstf.nasa.gov
8	Steve Compbell	JSC	(281) 483-3200	stephen.p.campbell1@jsc.nasa.gov
9	Thom Arceneaux	GSFC/WFF	(757) 824-7342	thomas.w.arceneaux.1@gsfc.nasa.gov
10	Pat Kolkmeier	JSC	(281) 483-3131	patricia.o.kolkmeier@jsc.nasa.gov
11	Ron Dilustro	HQ-JX	(202) 658-1129	ronald.dilustro@hq.nasa.gov
12	Tom Snow	GSFC/224	(301) 286-5901	tsnow@pop200.gsfc.nasa.gov
13	G.R. Rupnarain	MAF/LM	(504) 252-1894	guridat.rupnarain@maf.nasa.gov
14	Charles Kilgore	MSFC	(256) 544-9437	charles.kilgore@msfc.nasa.gov
15	Tam Antoine	JPL	(818) 354-4206	tam.antoine@jpl.nasa.gov
16	Edd Gibson	UT	(512) 471-4522	egibson@mail.utexas.edu
17	Ben Barrow	UT	(512) 471-7651	barrowb@mail.utexas.edu

Appendix C: PDRI for Building Projects Scoresheets

PROJECT SCORE SHEET (WEIGHTED)

SECTION I - BASIS OF PROJECT DECISION							
	Definition Level						Score
CATEGORY Element	0	1	2	3	4	5	
A. BUSINESS STRATEGY (Maximum = 214)							
A1. Building Use	0	1	12	23	33	44	
A2. Business Justification	0	1	8	14	21	27	
A3. Business Plan	0	2	8	14	20	26	
A4. Economic Analysis	0	2	6	11	16	21	
A5. Facility Requirements	0	2	9	16	23	31	
A6. Future Expansion/Alteration Considerations	0	1	7	12	17	22	
A7. Site Selection Considerations	0	1	8	15	21	28	
A8. Project Objectives Statement	0	1	4	8	11	15	
				CATEGORY A TOTAL			
B. OWNER PHILOSOPHIES (Maximum = 68)							
B1. Reliability Philosophy	0	1	5	10	14	18	
B2. Maintenance Philosophy	0	1	5	9	12	16	
B3. Operating Philosophy	0	1	5	8	12	15	
B4. Design Philosophy	0	1	6	10	14	19	
				CATEGORY B TOTAL			
C. PROJECT REQUIREMENTS (Maximum = 131)							
C1. Value-Analysis Process	0	1	6	10	14	19	
C2. Project Design Criteria	0	1	7	13	18	24	
C3. Evaluation of Existing Facilities	0	2	7	13	19	24	
C4. Scope of Work Overview	0	1	5	9	13	17	
C5. Project Schedule	0	2	6	11	15	20	
C6. Project Cost Estimate	0	2	8	15	21	27	
				CATEGORY C TOTAL			
Section I Maximum Score = 413 **SECTION I TOTAL**							

Definition Levels

0 =Not Applicable **2 =Minor Deficiencies** **4 =Major Deficiencies**
1 =Complete Definition **3 =Some Deficiencies** **5 =Incomplete or Poor Definition**

SECTION II - BASIS OF DESIGN							
	Definition Level						
CATEGORY Element	0	1	2	3	4	5	Score
D. SITE INFORMATION (Maximum = 108)							
D1. Site Layout	0	1	4	7	10	14	
D2. Site Surveys	0	1	4	8	11	14	
D3. Civil/Geotechnical Information	0	2	6	10	14	19	
D4. Governing Regulatory Requirements	0	1	4	8	11	14	
D5. Environmental Assessment	0	1	5	9	12	16	
D6. Utility Sources with Supply Conditions	0	1	4	7	10	13	
D7. Site Life Safety Considerations	0	1	2	4	6	8	
D8. Special Water and Waste Treatment Requirements	0	1	3	6	8	11	
CATEGORY D TOTAL							
E. BUILDING PROGRAMMING (Maximum = 162)							
E1. Program Statement	0	1	5	9	12	16	
E2. Building Summary Space List	0	1	6	11	16	21	
E3. Overall Adjacency Diagrams	0	1	3	6	8	10	
E4. Stacking Diagrams	0	1	4	7	10	13	
E5. Growth & Phased Development	0	1	5	8	12	15	
E6. Circulation and Open Space Requirements	0	1	4	7	10	13	
E7. Functional Relationship Diagrams/Room by Room	0	1	3	5	8	10	
E8. Loading/Unloading/Storage Facilities Requirements	0	1	2	4	6	8	
E9. Transportation Requirements	0	1	3	5	7	9	
E10. Building Finishes	0	1	5	8	12	15	
E11. Room Data Sheets	0	1	4	7	10	13	
E12. Furnishings, Equipment, & Built-Ins	0	1	4	8	11	14	
E13. Window Treatment	0	0	2	3	4	5	
CATEGORY E TOTAL							
F. BUILDING/PROJECT DESIGN PARAMETERS (Maximum = 122)							
F1. Civil/Site Design	0	1	4	7	11	14	
F2. Architectural Design	0	1	7	12	17	22	
F3. Structural Design	0	1	5	9	14	18	
F4. Mechanical Design	0	2	6	11	15	20	
F5. Electrical Design	0	1	5	8	12	15	
F6. Building Life Safety Requirements	0	1	3	5	8	10	
F7. Constructability Analysis	0	1	4	8	11	14	
F8. Technological Sophistication	0	1	3	5	7	9	
CATEGORY F TOTAL							

SECTION II - BASIS OF DESIGN							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
G. EQUIPMENT (Maximum = 36)							
G1. Equipment List	0	1	5	8	12	15	
G2. Equipment Location Drawings	0	1	3	5	8	10	
G3. Equipment Utility Requirements	0	1	4	6	9	11	
CATEGORY G TOTAL							
Section II Maximum Score = 428 **SECTION II TOTAL**							

Definition Levels

0 =Not Applicable **2 =Minor Deficiencies** **4 =Major Deficiencies**
1 =Complete Definition **3 =Some Deficiencies** **5 =Incomplete or Poor Definition**

SECTION III - EXECUTION APPROACH							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
H. PROCUREMENT STRATEGY (Maximum = 25)							
H1. Identify Long Lead/Critical Equip. & Materials	0	1	4	7	10	14	
H2. Procurement Procedures and Plans	0	1	3	6	9	11	
				CATEGORY H TOTAL			
J. DELIVERABLES (Maximum = 11)							
J1. CADD/Model Requirements	0	0	1	2	3	4	
J2. Documentation/Deliverables	0	1	2	4	6	7	
				CATEGORY J TOTAL			
K. PROJECT CONTROL (Maximum = 63)							
K1. Project Quality Assurance and C Control	0	1	3	4	6	8	
K2. Project Cost Control	0	1	4	7	10	13	
K3. Project Schedule Control	0	1	4	8	11	14	
K4. Risk Management	0	1	6	10	14	18	
K5. Safety Procedures	0	1	3	5	7	9	
				CATEGORY K TOTAL			
L. PROJECT EXECUTION PLAN (Maximum = 60)							
L1. Project Organization	0	1	3	5	8	10	
L2. Owner Approval Requirements	0	1	4	6	9	11	
L3. Project Delivery Method	0	1	5	8	12	15	
L4. Design/Construction Plan & .Approach	0	1	4	8	11	15	
L5. Substantial Completion Requirements	0	1	3	5	7	9	
				CATEGORY L TOTAL			
Section III Maximum Score = 159 SECTION III TOTAL							

PDRI TOTAL SCORE

(Maximum Score = 1000)

PROJECT SCORE SHEET (UNWEIGHTED)

SECTION I - BASIS OF PROJECT DECISION							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
A. BUSINESS STRATEGY							
A1. Building Use							
A2. Business Justification							
A3. Business Plan							
A4. Economic Analysis							
A5. Facility Requirements							
A6. Future Expansion/Alteration Considerations							
A7. Site Selection Considerations							
A8. Project Objectives Statement							
B. OWNER PHILOSOPHIES							
B1. Reliability Philosophy							
B2. Maintenance Philosophy							
B3. Operating Philosophy							
B4. Design Philosophy							
C. PROJECT REQUIREMENTS							
C1. Value-Analysis Process							
C2. Project Design Criteria							
C3. Evaluation of Existing Facilities							
C4. Scope of Work Overview							
C5. Project Schedule							
C6. Project Cost Estimate							

Definition Levels

0 =Not Applicable **2 =Minor Deficiencies** **4 =Major Deficiencies**
1 =Complete Definition **3 =Some Deficiencies** **5 =Incomplete or Poor Definition**

SECTION II - BASIS OF DESIGN							
	Definition Level						Score
CATEGORY Element	0	1	2	3	4	5	
D. SITE INFORMATION							
D1. Site Layout							
D2. Site Surveys							
D3. Civil/Geotechnical Information							
D4. Governing Regulatory Requirements							
D5. Environmental Assessment							
D6. Utility Sources with Supply C Conditions							
D7. Site Life Safety Considerations							
D8. Special Water and Waste Treatment Requirements							
E. BUILDING PROGRAMMING							
E1. Program Statement							
E2. Building Summary Space List							
E3. Overall Adjacency Diagrams							
E4. Stacking Diagrams							
E5. Growth & Phased Development							
E6. Circulation and Open Space Requirements							
E7. Functional Relationship Diagrams/Room by Room							
E8. Loading/Unloading/Storage Facilities Req'mts							
E9. Transportation Requirements							
E10. Building Finishes							
E11. Room Data Sheets							
E12. Furnishings, Equipment, & Built-Ins							
E13. Window Treatment							
F. BUILDING/PROJECT DESIGN PARAMETERS							
F1. Civil/Site Design							
F2. Architectural Design							
F3. Structural Design							
F4. Mechanical Design							
F5. Electrical Design							
F6. Building Life Safety Requirements							
F7. Constructability Analysis							
F8. Technological Sophistication							

SECTION II - BASIS OF DESIGN							
	Definition Level						Score
CATEGORY Element	0	1	2	3	4	5	
G. EQUIPMENT							
G1. Equipment List							
G2. Equipment Location Drawings							
G3. Equipment Utility Requirements							

Definition Levels

0 =Not Applicable **2 =Minor Deficiencies** **4 =Major Deficiencies**
1 =Complete Definition **3 =Some Deficiencies** **5 =Incomplete or Poor Definition**

SECTION III - EXECUTION APPROACH							
CATEGORY Element	Definition Level						Score
	0	1	2	3	4	5	
H. PROCUREMENT STRATEGY							
H1. Identify Long Lead/Critical Equip. & Materials							
H2. Procurement Procedures and Plans							
J. DELIVERABLES							
J1. CADD/Model Requirements							
J2. Documentation/Deliverables							
K. PROJECT CONTROL							
K1. Project Quality Assurance and Control							
K2. Project Cost Control							
K3. Project Schedule Control							
K4. Risk Management							
K5. Safety Procedures							
L. PROJECT EXECUTION PLAN							
L1. Project Organization							
L2. Owner Approval Requirements							
L3. Project Delivery Method							
L4. Design/Construction Plan & Approach							
L5. Substantial Completion Requirements							

PDRI TOTAL SCORE

(Maximum Score = 1000)

Appendix D: Element Descriptions

The following descriptions have been developed to help generate a clear understanding of the terms used in the Project Score Sheets located in Appendices A and B. Some descriptions include checklists to clarify concepts and facilitate ideas when scoring each element. NASA-specific descriptions are annotated in bold text. Commentary referencing NASA-specific processes is placed in parenthesis. Note that these checklists are not all-inclusive and the user may supplement these lists when necessary.

The descriptions are listed in the same order as they appear in the Project Score Sheet. They are organized in a hierarchy by section, category, and element. The Project Score Sheet consists of three main sections, each of which is broken down into a series of categories which, in turn, are further broken down into elements. Scoring is performed by evaluating the levels of definition of the elements, which are described in this attachment. The sections and categories are organized as follows:

SECTION I BASIS OF PROJECT DECISION

This section consists of information necessary for understanding the project objectives. The completeness of this section determines the degree to which the project team will be able to achieve alignment in meeting the project's business objectives.

Categories:

A - Business Strategy
B - Owner Philosophies
C - Project Requirements

SECTION II BASIS OF DESIGN

This section consists of space, site, and technical design elements that should be evaluated to fully understand the basis for design of the project.

Categories:

D - Site Information
E - Building Programming
F - Building/Project Design Parameters
G - Equipment

SECTION III EXECUTION APPROACH

This section consists of elements that should be evaluated to fully understand the requirements of the owner's execution strategy.

Categories:

H - Procurement Strategy
J - Deliverables
K - Project Control
L - Project Execution Plan

The following pages contain detailed descriptions for each element in the PDRI.

SECTION I - BASIS OF PROJECT DECISION

A. BUSINESS STRATEGY

A1. Building Use

Identify and list building uses or functions. These may include uses such as:

- ❑ Retail
- ❑ Institutional
- ❑ Instructional
- ❑ Medical
- ❑ Research
- ❑ Multimedia
- ❑ Office
- ❑ Light manufacturing
- ❑ Other
- ❑ Storage
- ❑ Food service
- ❑ Recreational
- ❑ **Aircraft Operations**

A description of other options which could also meet the facility need should be defined. (As an example, did we consider renovating existing space rather than building new space?) A listing of current facilities that will be vacated due to the new project should be produced.

A2. Business Justification

Identify driving forces for the project and specify what is most important from the viewpoint of the owner including both needs and expectations. Address items such as:

- ❑ Possible competitors
- ❑ Level of amenities
- ❑ Location
- ❑ Sales or rental levels
- ❑ Market capacity
- ❑ Use flexibility
- ❑ **Alignment with NASA Strategic Plan and Center of Excellence guidelines**
- ❑ **Core Capability**
- ❑ Need date
- ❑ Target consumers
- ❑ Building utilization justification
- ❑ Number of lessors/occupant types
- ❑ Support new business initiatives
- ❑ Facility replacement/consolidation
- ❑ Other

A3. Business Plan

A project strategy should be developed that supports the business justification in relation to the following items:

- ❑ Funding availability
- ❑ Cost and financing
- ❑ Schedule milestones (including known deadlines)
- ❑ Types and sources of project funds
- ❑ Related/resulting projects
- ❑ Other

(Parts of this element may be applicable to NASA Form 1509)
Note: If NASA 3rd party agreement, additional steps required

A4. Economic Analysis

An economic model should be developed to determine the viability of the venture. The model should acknowledge uncertainty and outline the boundaries of the analysis. It should acknowledge items such as:

- ❑ Design life
- ❑ Building Ownership
- ❑ Long-term operating and maintenance costs
- ❑ Resale/lease potential or in the case of institutional buildings, long term use plans
- ❑ Analysis of capital and operating cost versus sales or occupancy and profitability
- ❑ Other

(Parts of this element may be applicable to NASA Form 1510)

A5. Facility Requirements

Facility size requirements are many times determined by applicable code and are often driven by occupancy. Note that this analysis is at the macro level. Some considerations are listed below:

- ❑ Number of occupants
- ❑ Volume
- ❑ Net and gross space requirements by area uses
- ❑ Support infrastructure
- ❑ Classroom size
- ❑ Linear meters of display space
- ❑ Number of laboratory stations
- ❑ Occupant accommodation requirements (i.e., number of hospital beds, number of desks, number of workstations, on-site child care, on-site medical care, cot space, etc.)
- ❑ Other

A6. Future Expansion/Alteration Considerations

The possibility of expansion and/or alteration of the site and building should be considered for facility design. These considerations consist of a list of items that will facilitate the expansion or evolution of building use including adaptability/flexibility. Evaluation criteria may include:

- ❑ Provisions for site space in case of possible future expansion up or out
- ❑ Technologically advanced facility requirements
- ❑ Are departments or functional areas intended to "grow in place" during the future phase?
- ❑ If there will not be a future expansion of the building, how will departments or areas expand?
- ❑ Are any functional areas more likely than others to move out of the building in the future to allow others to expand or move in?
- ❑ Who will occupy the building in 5, 10, 15, 20 years?
- ❑ Flexibility or adaptability for future uses.
- ❑ Future phasing plan
- ❑ Other

A7. Site Selection Considerations

Evaluation of sites should address issues relative to different locations (i.e., global, country, or local). This evaluation may take into consideration existing buildings or properties, as well as new locations. The selection criteria include items such as:

- ❑ General geographic location
  - ❑ Access to the targeted market area
  - ❑ Local availability and cost of skilled labor (e.g., construction, operation)
  - ❑ Available utilities
  - ❑ Existing facilities
  - ❑ Economic incentive zones
  - ❑ Tax
- ❑ Land availability and developed costs
- ❑ Legal constraints
- ❑ Unusual financing requirements in region/locality
- ❑ Domestic culture vs. international culture
- ❑ Community relations
- ❑ Labor relations
- ❑ Government relations
- ❑ Political issues/constraints
- ❑ Education/training
- ❑ Safety and health considerations
- ❑ Environmental issues
- ❑ Symbolic and aesthetic
- ❑ Historic preservation
- ❑ Weather/climate
- ❑ Permitting Schedule
- ❑ **Master Plan Considerations**
- ❑ Other

A8. Project Objectives Statement

This statement defines the project objectives and priorities for meeting the business strategy. It should be clear, concise, measurable, and specific to the project. It is desirable to obtain total agreement from the entire project team regarding these objectives and priorities to ensure alignment. Specifically, the priorities among cost, schedule, and value-added quality features should be clear. The objectives also should comply with any master plans if applicable.

(Parts of this element may be applicable to NASA Form 1509 and/or the Management Plan)

B. OWNER PHILOSOPHIES

B1. Reliability Philosophy

A brief description of the project intent in terms of reliability should be defined. A list of the general design principles to be considered to achieve optimum/ideal operating performance from the facility/building should be addressed. Considerations may include:

- ❑ Critical systems redundancy
- ❑ Architectural/structural/civil durability
- ❑ Mechanical/electrical/plumbing reliability
- ❑ Other

B2. Maintenance Philosophy

A list of the general design principles to be considered to meet building maintenance requirements should be identified. This evaluation should include life cycle cost analysis of major facilities. Considerations may include:

- ❑ Daily occupancy loads
- ❑ Maximum building occupancy requirements
- ❑ Equipment monitoring requirements
- ❑ Energy conservation programs
- ❑ Selection of materials & finishes
- ❑ Requirements for building finishes
- ❑ **Reliability Centered Maintenance Program requirements**
- ❑ Other

(Refer to Center specific maintenance requirements)

B3. Operating Philosophy

A list of the general design issues that need to be considered to support routine operations should be developed. Issues may include:

- ❑ Operating schedule/hours
- ❑ Provisions for building rental or occupancy assignments (i.e., by room, floor, suite) including flexibility of partitioning
- ❑ Future renovation schedule

- ❑ User finish out philosophy
- ❑ Flexibility to change layout
- ❑ Other

B4. Design Philosophy

A listing of design philosophy issues should be developed. These issues should be directed at concerns such as the following:

- ❑ Design life
- ❑ Aesthetic requirements
- ❑ Compatibility with master plan
- ❑ Theme
- ❑ Image
- ❑ Environmentally sustainable design (internal/external)
- ❑ Quality of life
- ❑ **Design for maintainability**
- ❑ Other

C. PROJECT REQUIREMENTS

C1. Value-Analysis Process

A structured value analysis approach should be in place to consider design and material alternatives in terms of their cost effectiveness. Items that impact the economic viability of the project should be considered. Items to evaluate include issues such as:

- ❑ Discretionary scope issues
- ❑ Expensive materials of construction
- ❑ Life-cycle analysis of construction methods and structure
- ❑ Other

C2. Project Design Criteria

Project design criteria are the requirements and guidelines which govern the design of the project. Any design review board or design review process should be clearly articulated. Evaluation criteria may include:

- ❑ Level of design detail required
- ❑ Climatic data
- ❑ Codes & standards
  - ❑ National ❑ Local ❑ **Randolph-Sheppard Act**
  - ❑ **Govm't & NASA specific** ❑ International
- ❑ Utilization of design standards
  - ❑ **Govm't & NASA** ❑ Contractor's
  - ❑ Designer's ❑ Mixed
  - ❑ Level of design detail required
- ❑ **3rd Party requirements**
- ❑ Sole source requirements for equipment or systems
- ❑ Insurance underwriter requirements
- ❑ Cultural preferences
- ❑ Other

C3. Evaluation of Existing Facilities

If existing facilities are available, then a condition assessment must be performed to determine if they will meet facility requirements. Evaluation criteria may include:

- ❑ Capacity
  - ❑ Power
  - ❑ Utilities (i.e., potable water, gas, oil, etc.)
  - ❑ Fire water
  - ❑ Waste treatment/disposal
  - ❑ Sanitary sewer
  - ❑ Telecommunications
  - ❑ Security system/filtration
  - ❑ Storm water containment
- ❑ Access
  - ❑ Rail
  - ❑ ADA or local standards
  - ❑ Roads
- ❑ Parking areas
- ❑ Type and size of buildings/structures
- ❑ Amenities
  - ❑ Food service
  - ❑ Ambulatory access
  - ❑ Medical facilities
  - ❑ Recreation facilities including public outdoor spaces
  - ❑ Change rooms
- ❑ Condition assessment of existing facilities and infrastructure **(Includes existing safety and occupational health conditions that need correction.)**
- ❑ **Assess availability and condition of As-Built drawings**
- ❑ Other

C4. Scope of Work Overview

This work statement overview is a complete narrative description of the project that is discipline-oriented and supports development of the project schedule and project cost estimate. It sets the limits of work by each involved party and generally articulates their financial, task, and contractual responsibilities. It clearly states both assumptions and exclusions used to define the scope of work.

(Parts of this element may be applicable to NASA Form 1509)

C5. Project Schedule

Ideally, the project schedule should be developed by the project team (owner, A/E, and construction contractor). It should include milestones, unusual schedule considerations and appropriate master schedule "contingency" time (float), procurement of long lead or critical pacing equipment, and required submissions and approvals.

C6. Project Cost Estimate

The project cost estimate should address all costs necessary for completion of the project. This cost estimate may include the following:

- ❑ Construction contract estimate
- ❑ Professional fees
- ❑ Land cost
- ❑ Furnishings
- ❑ Administrative costs
- ❑ Contingencies
- ❑ Cost escalation for elements outside the project cost estimate
- ❑ Startup costs including installation
- ❑ Miscellaneous expenses including but not limited to:
  - ❑ Specialty consultants
  - ❑ Inspection & testing services
  - ❑ Bidding costs
  - ❑ Site clearance
  - ❑ Bringing utilities to the site
  - ❑ Environmental impact mitigation measures
  - ❑ Local authority permit fees
  - ❑ Occupant moving & staging costs
  - ❑ Utility costs during construction (if paid by owner)
  - ❑ Interest on borrowed funds (cost of money)
  - ❑ Site surveys, soils tests
  - ❑ Availability of construction laydown & storage at site or in remote or rented facilities
- ❑ Other

(NASA Form 1510 is a summary of the detailed cost estimate)
(Portions of the cost estimate also apply to NASA Form 1509)

SECTION II - BASIS OF DESIGN

D. SITE INFORMATION

D1. Site Layout

The facility should be sited on the selected property. Layout criteria may include items such as:

- ❑ Access (e.g., road, rail, marine, air, etc.)
- ❑ Construction access
- ❑ Historical/cultural
- ❑ Trees, vegetation and **wildlife**
- ❑ Site massing and context constraints or guidelines (i.e., how a building will look in 3-dimensions at the site)
- ❑ Access transportation parking, delivery/service, & pedestrian circulation considerations
- ❑ Open space, street amenities, "urban context concerns"
- ❑ Climate, wind, and sun orientation for natural lighting views, heat loss/gain, energy conservation, and aesthetic concerns
- ❑ **Safety and occupational health issues**
- ❑ **Blast area and quantity distance considerations**
- ❑ Other

D2. Site Surveys

The site should be surveyed for the exact property boundaries, including limits of construction. A topography map with the overall plot and site plan is also needed. Evaluation criteria may include:

- ❑ Legal property descriptions with property lines
- ❑ Easements
- ❑ Rights-of-way
- ❑ Drainage patterns
- ❑ Deeds
- ❑ Definition of final site elevation
- ❑ Benchmark control systems
- ❑ Setbacks
- ❑ Access & curb cuts
- ❑ Proximity to drainage ways and flood plains
- ❑ Known below grade structures and utilities (both active and inactive)
- ❑ Trees, vegetation and **wildlife**
- ❑ Existing facility locations and conditions
- ❑ Solar/shadows
- ❑ Other

D3. Civil/Geotechnical Information

The civil/geotechnical site evaluation provides a basis for foundation, structural, and hydrological design. Evaluations of the proposed site should include items such as:

- ❑ Depth to bedrock
- ❑ General site description (e.g., terrain, soils type, existing structures, spoil removal, areas of hazardous waste, etc.)
- ❑ Expansive or collapse potential of soils
- ❑ Fault line locations
- ❑ Spoil area for excess soil (i.e., location of on-site area or off-site instructions)
- ❑ Seismic requirements
- ❑ Water table elevation
- ❑ Flood plain analysis
- ❑ Soil percolation rate & conductivity
- ❑ Ground water flow rates and directions
- ❑ Need for soil treatment or replacement
- ❑ Description of foundation design options
- ❑ Allowable bearing capacities
- ❑ Pier/pile capacities
- ❑ Paving design options
- ❑ Overall site analysis
- ❑ **Demolition requirements**
- ❑ Other

D4. Governing Regulatory Requirements

The local, state, and federal government permits necessary to construct and operate the facility should be identified. A work plan should be in place to prepare, submit, and track permit, regulatory, re-zoning, and code compliance for the project. It should include items such as:

❑ Construction	❑ Fire	❑ Accessibility
❑ Unique requirements	❑ Building	❑ Demolition
❑ Environmental	❑ Occupancy	❑ Solar
❑ Structural calculations	❑ Special	❑ Platting
❑ Building height limits	❑ Signage	❑ Air/water
❑ Setback requirements	❑ Historical issues	❑ Transportation

- ❑ **National Resource Protection Act**
- ❑ Other

The codes that will have a significant impact on the scope of the project should also be investigated and explained in detail. Particular attention should be paid to local requirements. Regulatory and code requirements may affect the defined physical characteristics and project cost estimate. The project schedule may be affected by regulatory approval processes. For some technically complex buildings, regulations change fairly often.

D5. Environmental Assessment

An environmental assessment should be performed for the site to evaluate issues that can impact the cost estimate or delay the project. These issues may include:

- ❑ Archeological
- ❑ Location in an EPA air quality non-compliance zone
- ❑ Location in a wet lands area
- ❑ Environmental permits now in force
- ❑ Existing contamination
- ❑ Location of nearest residential area
- ❑ Ground water monitoring in place
- ❑ Downstream uses of ground water
- ❑ Existing environmental problems with the site
- ❑ Past/present use of site
- ❑ Noise/vibration requirements
- ❑ Air/water discharge requirements and options evaluated
- ❑ Discharge limits of sanitary and storm sewers identified
- ❑ Detention requirements
- ❑ Endangered species
- ❑ Erosion/sediment control
- ❑ **Neighborhood concerns**
- ❑ **HAZMAT mitigation (asbestos, lead paint, mercury...etc.)**
- ❑ **National Environmental Policy Act requirements**
- ❑ Other

D6. Utility Sources with Supply Conditions

The availability/non-availability of site utilities needed to operate the facility with supply conditions of quantity, temperature, pressure, and quality should be evaluated. This may include items such as:

- ❑ Potable water
- ❑ Drinking water
- ❑ Cooling water
- ❑ Fire water
- ❑ Sewers
- ❑ Instrument air
- ❑ Facility air
- ❑ Heating water
- ❑ Gases
- ❑ Steam
- ❑ Electricity (voltage levels)
- ❑ Communications (e.g., data, cable television, telephones)
- ❑ Special requirement (e.g., deionized water or oxygen)
- ❑ **Central air and Vacuum systems**

- ❑ **Cryogenics**
- ❑ Other

(Refer to element G3 for specific equipment requirements)

D7. Site Life Safety Considerations

Fire and life safety related items should be taken into account for the selected site. These items should include fire protection practices at the site, available firewater supply (amounts and conditions), special safety requirements unique to the site, etc. Evaluation criteria may include:

- ❑ Wind direction indicator devices (e.g., wind socks)
- ❑ Fire monitors & hydrants
- ❑ Flow testing
- ❑ Access and evacuation plan
- ❑ Available emergency medical facilities
- ❑ Security considerations (site illumination, access control, etc.)
- ❑ Other

D8. Special Water and Waste Treatment Requirements

On-site or pretreatment of water and waste should be evaluated. Items for consideration may include:

- ❑ Wastewater treatment
  - ❑ Process waste
  - ❑ Sanitary waste
- ❑ Waste disposal
- ❑ Storm water containment & treatment
- ❑ Other

E. BUILDING PROGRAMMING

E1. Program Statement (Refer to Building Requirements Document)

The program statement identifies the levels of performance for the facility in terms of space planning and functional relationships. It should address the human, physical, and external aspects to be considered in the design. Each performance criteria should include these issues:

- ❑ A performance statement outlining what goals are to be attained (e.g., providing sufficient lighting levels to accomplish the specified task safely and efficiently)
- ❑ A measure that must be achieved (e.g., 200 foot-candles at surface of surgical table)
- ❑ A test which is an accepted approach to establish that the criterion has been met (e.g., using a standard light meter to do the job)
- ❑ Other

E2. Building Summary Space List

The *summary* space list includes *all* space requirements for the entire project. This list should address specific types and areas. Possible space listings include:

- ❑ Building population
- ❑ Administrative offices
- ❑ Lounges
- ❑ Food Service Cafeteria
- ❑ Conference rooms
- ❑ Vending alcoves
- ❑ Janitorial closets
- ❑ Elevators
- ❑ Stairs
- ❑ Loading docks
- ❑ **Fabrication areas**
- ❑ Dwelling units
- ❑ Special technology considerations
- ❑ Classrooms
- ❑ Laboratories
- ❑ Corridors
- ❑ Storage facilities
- ❑ Mechanical rooms
- ❑ Electrical rooms
- ❑ Parking space
- ❑ Entry lobby
- ❑ Restrooms
- ❑ Data/computer areas
- ❑ **Hangar Space**
- ❑ **Clean rooms**
- ❑ Other considerations

A room data sheet should correspond to each entry on the summary space list. Room data sheets are discussed in element E11. The room data sheet contains information that is necessary for the summary space list. This list is used to determine assignable (usable) and non-assignable (gross) areas.

E3. Overall Adjacency Diagrams

The overall adjacency diagrams depict the layout of each department or division of the entire building. They show the relationship of specific rooms, offices, and sections. The adjacency diagrams must adequately convey the overall relationships between functional areas within the facility. Note that these diagrams are sometimes known as "bubble diagrams" or "balloon diagrams." They are also commonly expressed in an adjacency matrix.

E4. Stacking Diagrams

A stacking diagram portrays each department or functional unit vertically in a multi-story building. Stacking diagrams are drawn to scale, and they can help establish key design elements for the building. These diagrams are easily created with space lists and adjacency (or bubble) diagrams. Critical vertical relationships may relate to circulatory (stairs, elevators), structural elements, and mechanical or utility shafts.

Stacking diagrams can establish building elements such as floor size. This type of diagram often combines functional adjacencies and space requirements and also shows how the project is sited.

(Conduct safety evaluations to determine operational issues)

E5. Growth and Phased Development

Provisions for future phases or anticipated use change must be considered during project programming. A successful initial phase necessitates a plan for the long term phases. The following phasing issues may be addressed.

- ❑ Guidelines to allow for additions (i.e., over-design of structural systems, joist layout, column spacing, etc.)
- ❑ Technology needs as facility grows and expands or changes (e.g., mechanical systems, water demands, etc.)
- ❑ Compare the additional costs involved with making the building "expandable" versus the probability of the future expansion occurring as envisioned.
- ❑ Provisions for infrastructure that allow for future expansion
- ❑ Other

E6. Circulation and Open Space Requirements

An important component of space programming is common-area open spaces, both interior and exterior. These areas include the items listed and considerations such as:

- ❑ Exterior
  - ❑ Service dock areas and access
  - ❑ Circulation to parking areas
  - ❑ Passenger drop-off areas
  - ❑ Pedestrian walkways
  - ❑ Courtyards, plazas, or parks
  - ❑ Landscape buffer areas
  - ❑ Unbuildable areas (e.g., wetlands or slopes)
  - ❑ Sidewalks or other pedestrian routes
  - ❑ Bicycle facilities
  - ❑ Lobbies and entries
  - ❑ Security considerations (e.g., card access or transmitters)
  - ❑ Snow removal plan
  - ❑ Postal and newspaper delivery
  - ❑ Waste removal
  - ❑ Fire and life-safety circulation considerations
- ❑ Interior
  - ❑ Interior aisle ways and corridors

- ❑ Vertical circulation (i.e., personnel & material transport including elevators and escalators)
- ❑ Directional and location signage
- ❑ **Fire and life-safety circulation considerations**
- ❑ Other

E7. Functional Relationship Diagrams/Room by Room

Room by room functional relationship diagrams show the structure of adjacencies of a group of rooms. With these adjacency diagrams (also known as bubble diagrams), the architect can convert them into a floor plan with all the relationships. Each space detail sheet should have a minimum of one functional relationship diagram. Rooms are often represented by circles, bubbles, squares, or rectangles. Larger rooms are represented with bigger symbols. They are also commonly expressed in an adjacency matrix.

E8. Loading/Unloading/Storage Facilities Requirements

A list of requirements identifying materials to be unloaded and stored and products to be loaded along with their specifications. This list should include items such as:

- ❑ Storage facilities to be provided and/or utilized
- ❑ Refrigeration requirements and capabilities
- ❑ Mail/small package delivery
- ❑ Recycling requirements
- ❑ **Material handling (including staging between lab facilities)**
- ❑ **Research and operational requirements**
- ❑ Other

E9. Transportation Requirements

Specifications for implementation of facility transportation (e.g., roadways, conveyers, elevators, etc.) as well as methods for receiving and shipping of materials (e.g., air, rail, truck, marine, etc.) should be identified. Provisions should be included for items such as:

- ❑ Facility access requirements based on transportation
- ❑ Drive-in doors
- ❑ Extended ramps for low clearance trailers
- ❑ Rail car access doors

- ❑ Service elevators
- ❑ Loading docks
- ❑ Temporary parking
- ❑ Other

E10. Building Finishes

Levels of interior and exterior finishes should be defined for the project. For example, the finishes may include categories such as:

<u>Interior Schedule:</u>

- ❑ Type A
  - ❑ Floor: vinyl composition tile
  - ❑ Walls: painted
- ❑ Type B
  - ❑ Floor: direct glue carpet
  - ❑ Walls: vinyl wall covering
- ❑ Type C
  - ❑ Floor: carpet over pad
  - ❑ Walls: wood paneling
  - ❑

<u>Exterior Schedule:</u>

- ❑ Type 1
  - ❑ Walls: brick
  - ❑ Trim: brick
- ❑ Type 2
  - ❑ Walls: overlapping masonry
  - ❑ Trim: cedar

Finishes and local design standards are further defined in category F.

(Check Center specific standards)

E11. Room Data Sheets

Room data sheets contain the specific requirements for each room considering its functional needs. A room data sheet should correspond to each room on the building summary space list. The format of the room data sheet should be consistent. Possible issues to include on room data sheets are:

- ❑ Critical dimensions
- ❑ Technical requirements (e.g., fireproof, explosion resistance, X-ray, etc.)
- ❑ Furnishing requirements
- ❑ Equipment requirements
- ❑ Audio/visual (A/V) data and communication provisions
- ❑ Lighting requirements
- ❑ Utility requirements
- ❑ Security needs including access/hours of operation
- ❑ Finish type
- ❑ Environmental issues
- ❑ Acoustics/vibration requirements
- ❑ Life-safety
- ❑ **High Bay area requirements**
- ❑ **Special Equipment (Cranes, tooling and rigging requirements)**
- ❑ Other

E12. Furnishings, Equipment, and Built-Ins

All moveable furnishings, equipment, and built-ins should be listed on the room data sheets. Moveable and fixed in place equipment should be distinguished. Building modifications, such as wide access doors or high ceilings, necessary for any equipment also need to be listed. Long delivery time items should be identified and ordered early. It is critical to identify the utility impact of equipment (e.g., electrical, cooling, special water or drains, venting, radio frequency shielding, etc.). Examples may include:

- ❑ Furniture
- ❑ Kitchen equipment
- ❑ Medical equipment
- ❑ Material handling
- ❑ Partitions
- ❑ Other

New items and relocated existing items must be distinguished in the program. The items can be classified in the following categories.

("Owner" is typically the Government but could be a 3rd party supplier)

New Items:
- ☐ Contractor furnished and contractor installed
- ☐ Owner furnished and contractor installed
- ☐ Owner furnished and owner installed
- ☐ Other

Existing Items:
- ☐ Relocated as is and contractor installed
- ☐ Refurbished and installed by contractor
- ☐ Relocated as is and owner installed
- ☐ Refurbished and installed by owner
- ☐ Other

E13. Window Treatment

Any special fenestration window treatments for energy and/or light control should be noted in order to have proper use of natural light. Some examples include:
- ☐ Blocking of natural light
- ☐ Glare reducing windows
- ☐ Exterior louvers
- ☐ Interior blinds
- ☐ Other

F. BUILDING/PROJECT DESIGN PARAMETERS

F1. Civil/Site Design

Civil/site design issues should be addressed to provide a basis for facility design. Issues to address may include:

- ❑ Service and storage requirements
- ❑ Elevation and profile views
- ❑ High point elevations for grade, paving, and foundations
- ❑ Location of equipment
- ❑ Minimum overhead clearances
- ❑ Storm drainage system
- ❑ Location and route of underground utilities
- ❑ Site utilities
- ❑ Earth work
- ❑ Subsurface work
- ❑ Paving/curbs
- ❑ Landscape/xeriscape
- ❑ Fencing/site security
- ❑ **Exterior furnishings (Bus stops, benches, traffic lights, shade structures...etc.)**
- ❑ Other

F2. Architectural Design

Architectural design issue should be addressed to provide a basis for facility design. These issues may include the following:

- ❑ Determination of metric (hard/soft) versus Imperial (English) units
  (Note: The term "hard" metric means that materials and equipment are identified on the drawings and have to be delivered in metric-sized unit dimensions such as 200mm by 400mm. "Soft" metric means that materials and equipment can be delivered using sizes that approximate the metric dimensions given on the drawings, such as 3 inch length instead of 8 cm. It is important to set these dimensions and not "mix and match.")
- ❑ Requirements for building location/orientation horizontal & vertical
- ❑ Access requirements
- ❑ Nature/character of building design (e.g., aesthetics, etc.)
- ❑ Construction materials
- ❑ Acoustical considerations
- ❑ American with Disabilities Act requirements or other local access requirements
- ❑ Architectural Review Boards
- ❑ Planning & zoning review boards
- ❑ Circulation considerations
- ❑ Seismic design considerations
- ❑ Color/material standards
- ❑ Hardware standards
- ❑ Furniture, furnishings, and accessories criteria
- ❑ Design grid
- ❑ Floor to floor height
- ❑ Other

F3. Structural Design

Structural design considerations should be addressed to provide a basis for the facility design. These considerations may include the following:

- ❑ Structural system (e.g., construction materials, constraints, etc.)
- ❑ Seismic requirements
- ❑ Foundation system
- ❑ Corrosion control requirements/required protective coatings
- ❑ Client specifications (e.g., basis for design loads, vibration, deflection, etc.)
- ❑ Future expansion/flexibility considerations
- ❑ Design loading parameter (e.g., live/dead loads, design loads, collateral load capacity, equipment/material loads, wind/snow loads, uplift)
- ❑ Functional spatial constraints
- ❑ **Check hook height and tooling requirements**
- ❑ Other

F4. Mechanical Design

Mechanical design parameters should be developed to provide a basis for facility design. Items to consider include:

- ❑ Special ventilation or exhaust requirements
- ❑ Equipment/space special requirements with respect to environmental conditions (e.g., air quality, special temperatures)
- ❑ Energy conservation and life cycle costs
- ❑ Acoustical requirements
- ❑ Zoning and controls
- ❑ Air circulation requirements
- ❑ Outdoor design conditions (e.g., minimum and maximum yearly temperatures)
- ❑ Indoor design conditions (e.g., temperature, humidity, pressure, air quality, etc.)
- ❑ Building emissions control
- ❑ Utility support requirements
- ❑ System redundancy requirements
- ❑ Plumbing requirements
- ❑ Special piping requirements
- ❑ Seismic requirements
- ❑ Other

F5. Electrical Design

Electrical design parameters provide the basis for facility design. Consider items such as:

- ❑ Power sources with available voltage & amperage
- ❑ Special lighting considerations (e.g., lighting levels, color rendition)
- ❑ Voice, data, and video communications requirements
- ❑ Uninterruptable power source (UPS) and/or emergency power requirements
- ❑ Energy consumption/conservation and life cycle cost
- ❑ Ability to use daylight in lighting
- ❑ Seismic requirements
- ❑ Lightning/grounding requirements
- ❑ Other

F6. Building Life Safety Requirements

Building life safety requirements are a necessity for building operations. They should be identified at this stage of the project. Possible safety requirements are listed below:

- ❑ Fire resistant requirements
- ❑ Explosion resistant requirements
- ❑ Area of refuge requirements in case of catastrophe
- ❑ Safety and alarm requirements
- ❑ Fire detection and/or suppression requirements
- ❑ Eye wash stations
- ❑ Safety showers
- ❑ Deluge requirements and foam
- ❑ Fume hoods
- ❑ Handling of hazardous materials
- ❑ Isolation facilities
- ❑ Sterile environments
- ❑ Emergency equipment access
- ❑ Personnel shelters
- ❑ Egress
- ❑ Public address requirements

- ❑ Data or communications protection in case of disaster or emergency
- ❑ Fall hazard protection
- ❑ Gas hazard detection
- ❑ **Laser protection**
- ❑ **Planetary contamination protection**
- ❑ **Noise level requirements**
- ❑ **Ventilation requirements for restrooms, offices, and industrial areas**
- ❑ Other

F7. Constructability Analysis

CII defines constructability as, "the optimum use of construction knowledge and experience in planning, design, procurement, and field operations to achieve overall project objectives. Maximum benefits occur when people with construction knowledge and experience become involved at the very beginning of a project." Is there a structured approach for constructability analysis in place? Have provisions been made to provide this on an ongoing basis? This would include examining design options and details of construction that minimize construction costs while maintaining standards of safety, quality, and schedule. Elements of constructability during pre-project planning include:

- ❑ Constructability program in existence
- ❑ Construction knowledge/experience used in project planning
- ❑ Early construction involvement in contracting strategy development
- ❑ Developing a construction-sensitive project schedule
- ❑ Considering major construction methods in basic design approaches
- ❑ Developing site layouts for efficient construction
- ❑ Early identification of project team participants for constructability analysis
- ❑ Usage of advanced information technologies
- ❑ Other

F8. Technological Sophistication

The requirements for "intelligent" or special building systems should be evaluated. Examples of these systems may include:

- ❑ Video conferencing
- ❑ Internet connections
- ❑ Advanced audio/visual (A/V) connections
- ❑ Personnel sensing
- ❑ Computer docking stations
- ❑ "Smart" heating or air-conditioning
- ❑ Intercommunication systems
- ❑ Security systems
- ❑ Communication systems
- ❑ Conveyance systems
- ❑ **Remote systems operations**
- ❑ Other

G. EQUIPMENT

G1. Equipment List

Project-specific equipment should be defined and listed. (Note: Building systems equipment is addressed in element F4, Mechanical Design, and F5, Electrical Design). In situations where owners are furnishing equipment, the equipment should be properly defined and purchased. The list should define items such as:

- ❑ Process/**Laboratory**
- ❑ Medical
- ❑ Food service/vending
- ❑ Trash disposal
- ❑ Distributed control systems
- ❑ Material handling
- ❑ Existing sources and characteristics of equipment
  - ❑ Relative sizes
  - ❑ Weights
  - ❑ Location
  - ❑ Capacities
  - ❑ Materials of construction
  - ❑ Insulation and painting requirements
  - ❑ Equipment related access

- ❑ Vendor, model, and serial number once identified
- ❑ Equipment delivery time, if known

- ❑ **Trash chutes**
- ❑ **Equipment data sheet developed for each piece of equipment (Vendor data, utility requirements, special requirements)**
- ❑ Other

G2. Equipment Location Drawings

Equipment location/arrangement drawings identify the specific location of each item of equipment in a project. These drawings should identify items such as:

- ❑ Plan and elevation views of equipment and platforms
- ❑ Location of equipment rooms
- ❑ Physical support requirement (e.g., installation bolt patterns)
- ❑ Coordinates or location of all major equipment
- ❑ Other

G3. Equipment Utility Requirements

This evaluation should consist of a tabulated list of utility requirements for all major equipment items such as:

- ❑ Power and/or all utility requirements
- ❑ Flow diagrams
- ❑ Design temperature and pressure
- ❑ Diversity of use
- ❑ Gas
- ❑ Water
- ❑ Other

SECTION III - EXECUTION APPROACH

H. PROCUREMENT STRATEGY

H1. Identify Long Lead/Critical Equipment and Materials

Identify engineered equipment and material items with lead times that will impact the design for receipt of vendor information or impact the construction schedule with long delivery times.

(Parts of this element are applicable to Management Plan)

H2. Procurement Procedures and Plans

Procurement procedures and plans include specific guidelines, special requirements, or methodologies for accomplishing the purchasing, expediting, and delivery of equipment and materials required for the project. Evaluation criteria include:

- ❑ Who will perform procurement?
- ❑ Listing of approved vendors, if applicable
- ❑ Client or contractor purchase orders
- ❑ Reimbursement terms and conditions
- ❑ Guidelines for supplier alliances, single source, **Davis-Bacon**, or comp.bids
- ❑ Guidelines for engineering/construction contracts
- ❑ Who assumes responsibility for owner-**furnished** items?
    - ❑ Financial ❑ **Refurbishment**
    - ❑ Shop inspection
    - ❑ Expediting
- ❑ Tax strategy
    - ❑ Depreciation capture
    - ❑ Local sales and use tax treatment
    - ❑ Investment tax credits
- ❑ Definition of source inspection requirements and responsibilities
- ❑ Definition of traffic/insurance responsibilities
- ❑ Definition of procurement status reporting requirements
- ❑ Additional/special owner accounting requirements
- ❑ Definition of spare parts requirements
- ❑ Local regulations (e.g., tax restrictions, tax advantages, etc.)
- ❑ Incentive/penalty strategy for contracts

- ❑ Storage
- ❑ **Procedures in accordance with NASA FAR**
- ❑ **Definition of acceptance/commissioning criteria**
- ❑ Other

(Parts of this element are applicable to Management Plan)

J. DELIVERABLES

J1. CADD/Model Requirements

Computer Aided Drafting and Design (CADD) requirements should be defined. Evaluation criteria may include:

- ❑ Software system required by client (e.g., AutoCAD, Intergraph, etc.)
- ❑ Will the project be required to be designed using 2D or 3D CADD? Will rendering be required?
- ❑ If 3D CADD is to be used, will a walk-through simulation be required?
- ❑ Owner/contractor standard symbols and details
- ❑ How will data be received and returned to/from the owner?
  - ❑ Disk
  - ❑ Electronic transfer
  - ❑ Tape
  - ❑ Reproducibles
  - ❑ Full size mock-ups

Physical model requirements depend upon the type needed for analysis, such as study models or design checks.

J2. Documentation/Deliverables

Documentation and deliverables required during project execution should be identified. If electronic media are to be used, format and application packages should be outlined. The following items may be included in a list of deliverables:

- ❑ Drawings & specifications
- ❑ Project correspondence
- ❑ Permits
- ❑ Maintenance and operating information/startup procedures
- ❑ Facility keys, keying schedules, and access codes

- ❑ Project data books (quantity, format, contents, and completion date)
- ❑ Equipment folders (quantity, format, contents, and completion date)
- ❑ Design calculations (quantity, format, contents, and completion date)
- ❑ Spare parts and maintenance stock (special forms)
- ❑ Procuring documents/contract documents
- ❑ Record (as-built) documents
- ❑ Quality assurance documents
- ❑ Project signage
- ❑ Guarantees/warranties
- ❑ Inspection documents
- ❑ Certificates of inspection
- ❑ Shop drawings and samples
- ❑ Bonds
- ❑ Distribution matrix
- ❑ Other

K. PROJECT CONTROL

(Elements in this category identify special consideration not necessarily identified in FPIH guidance.)

K1. Project Quality Assurance and Control

Quality assurance and quality control procedures need to be established. Responsibility for approvals needs to be developed. Electronic media requirements should be outlined. These issues may include:

- ❑ Responsibility during design and construction
- ❑ Testing of materials and workmanship
- ❑ ISO 9000 requirements
- ❑ Submittals and shop drawing approach
- ❑ Inspection reporting requirements
- ❑ Progress photos
- ❑ Reviewing changes and modifications
- ❑ Communication documents (e.g., RFI's, RFQ's, etc.)
- ❑ Commissioning tests
- ❑ Lessons-learned feedback
- ❑ Other

K2. Project Cost Control

Procedures for controlling project cost need to be outlined and responsibility assigned. Electronic media requirements should be identified. These may include cost control requirements such as:

- ❑ Financial (client/regulatory)
- ❑ Phasing or area sub-accounting
- ❑ Capital vs. non-capital expenditures
- ❑ Report requirements
- ❑ Payment schedules and procedures
- ❑ Cash flow projections/draw down analysis
- ❑ Cost code scheme/strategy
- ❑ Costs for each project phase
- ❑ Periodic control check estimates
- ❑ Change order management procedure, including scope control
- ❑ Other

(Refer to appropriate NASA Quality Control documentation)

K3. Project Schedule Control

The project schedule is created to show progress and ensure that the project is completed on time. The schedule is necessary for design and construction of the building. A schedule format should be decided on at the beginning of the project. Typical items included in a project schedule are listed below:

- ❑ Milestones
- ❑ Unusual schedule considerations
- ❑ Required submissions and/or approvals
- ❑ Required documentation and responsible party
- ❑ Baseline vs. progress to date
- ❑ Long lead or critical pacing equipment delivery
- ❑ Critical path activities
- ❑ Contingency or "float time"
- ❑ Permitting or regulatory approvals
- ❑ Activation and commissioning
- ❑ Liquidated damages/incentives
- ❑ Other

The owner must also identify how special project issues will be scheduled. These items may include:

- ❑ Selection, procurement, and installation of equipment
- ❑ Design of interior spaces (including furniture and accessory selection)
- ❑ Stages of the project that must be handled differently than the rest of the project
- ❑ Tie-ins, service interruptions, and road closures
- ❑ Other

K4. Risk Management

Major project risks need to be identified, quantified, and management actions taken to mitigate problems developed. Pertinent elements may include:

- ❑ Design risks
  - ❑ Expertise
  - ❑ Experience
  - ❑ Work load
  - ❑ Teamwork orientation
  - ❑ Communication
  - ❑ Integration and coordination
  - ❑ Other

- ❑ Construction risks
  - ❑ Availability of craft labor and construction materials
  - ❑ Weather
  - ❑ Differing/unforeseen/difficult site conditions
  - ❑ Long lead item delays
  - ❑ Strikes
  - ❑ Inflation
  - ❑ Scope growth
  - ❑ **Worker Safety**
  - ❑ **Expertise**
  - ❑ **Experience**
  - ❑ Other

- ❑ Management risks
  - ❑ Availability of designers
  - ❑ Critical quality issues

- ❑ Bidders
- ❑ Human error
- ❑ Cost & schedule estimates
- ❑ Timely decisions
- ❑ Team chemistry
- ❑ Other

❑ Insurance considerations

K5. Safety Procedures

Safety procedures and responsibilities must be identified for design consideration and construction. Safety issues to be addressed may include:

- ❑ Hazardous material handling
- ❑ Interaction with the public
- ❑ Working at elevations/fall hazards
- ❑ Evacuation plans & procedures
- ❑ Drug testing
- ❑ First aid stations
- ❑ Accident reporting & investigation
- ❑ Pre-task planning
- ❑ Safety orientation & planning
- ❑ Safety incentives
- ❑ **Personal protective equipment**
- ❑ Other special or unusual safety issues

(Must perform Facility Safety Analysis prior to beginning of design)

L. PROJECT EXECUTION PLAN

(Many of the items in these elements are contained in the Management Plan)

L1. Project Organization

The project team should be identified including roles, responsibilities, and authority. Items to consider include:

- ❑ Core team members
- ❑ Project manager assigned
- ❑ Project sponsor assigned
- ❑ Working relationships between participants
- ❑ Communication channels
- ❑ Organizational chart
- ❑ Approval responsibilities/responsibility matrix
- ❑ Other

L2. Owner Approval Requirements

All documents that require owner approval should be clearly defined. These may include:

- ❑ Milestones for drawing approval by phase
    - ❑ Comment
    - ❑ Approval
    - ❑ Bid issues (public or private)
    - ❑ Construction
- ❑ Durations of approval cycle compatible with schedule
- ❑ Individual(s) responsible for reconciling comments before return
- ❑ Types of drawings/specifications
- ❑ Purchase documents/general conditions & contract documents
    - ❑ Data sheets
    - ❑ Inquiries
    - ❑ Bid tabulations
    - ❑ Purchase orders
- ❑ Vendor information
- ❑ Other

L3. Project Delivery Method

The methods of project design and construction delivery, including fee structure should be identified. Issues to consider include:

- ❑ Owner self-performed
- ❑ Designer and constructor qualification selection process
- ❑ Selected methods (e.g., design/build, CM at risk, competitive sealed proposal, bridging, design-bid-build, etc.)
- ❑ Contracting strategies (e.g., lump sum, cost-plus, etc.)
- ❑ Design/build scope package considerations
- ❑ Other

L4. Design/Construction Plan and Approach

This is a documented plan identifying the specific approach to be used in designing and constructing the project. It should include items such as:

- ❑ Responsibility matrix
- ❑ Subcontracting strategy
- ❑ Work week plan/schedule
- ❑ Organizational structure
- ❑ Work Breakdown Structure (WBS)
- ❑ Construction sequencing of events
- ❑ Site logistics plan
- ❑ Safety requirements/program
- ❑ Identification of critical activities that have potential impact on facilities (i.e., existing facilities, crane usage, utility shut downs and tie-ins, testing, etc.)
- ❑ Quality assurance/quality control (QA/QC) plan
- ❑ Design and approvals sequencing of events
- ❑ Equipment procurement and staging
- ❑ Contractor meeting/reporting schedule
- ❑ Partnering or strategic alliances
- ❑ Alternative dispute resolution
- ❑ Furnishings, equipment, and built-ins responsibility
- ❑ Other

Appendix E: PDRI Scoring Meeting Observation

17 Sep 99
Kingsolving Media Room, U of Texas at Austin

Background: The University of Texas Division of Housing and Food Service (DHFS) has acquired approval for a large-scale renovation project of its Jester Dining Commons and has invested a great deal of effort in Pre-Project Planning. The project is currently at the Schematic Design completion stage. The purpose of this meeting was to conduct an evaluation of the project planning efforts at the present point in time by utilizing the PDRI for Buildings. Even though a PDRI evaluation has been performed on a few other University of Texas construction projects, this is the first time the PDRI for Buildings was used to rate the planning of a Renovation project. The scoring of the PDRI was conducted by representatives from: Project management, Institution, User, General Contractor, Design Consultant, and Maintenance Division. (10 personnel in total) The evaluation took two hours.

Scope: To observe the actual use of the PDRI for Buildings on the evaluation of planning efforts for a Renovation project to:

- Note its overall validity to renovation projects.
- Note changes necessary to render it more useful to renovation projects.
- Note the overall scoring process and see if improvements could be made.

Observations:

- It appeared that in the initial stages of scoring, participants did not bear in mind the full basis of each of the elements being evaluated and that the overriding concern was getting a "good grade" rather than identifying areas warranting further attention.
- The team leader made concerted attempts at questioning the depths of element definition; however, the general tendency by the participants seemed to be to browse through the elements with no real depth. Generally, if there was dispute over a particular score, the lower (more favorable) one was picked.
- The use of a non-weighted score sheet seemed appropriate as it removed the tendency to let the weights influence the evaluation.
- As the scoring process progressed, some large areas of non-definition were discovered, creating a heightened sense of the value of the PDRI and closer attention to the details of each element. This awareness stimulated many follow-on discussions.
- The following elements were found to be not applicable to this particular renovation project:
    - A7. Site Selection Considerations 28
    - D2. Site Surveys 14
    - D3. Civil/Geotechnical information 19
    - F1 Civil/Site Design 14

Total: 75

- Even though the elements for the PDRI for buildings were developed with the construction of a new facility (and not the renovation of an existing one) in mind, all the element descriptions (except A7, D2, D3, F1) appeared to be common and broad enough to be useful for renovation projects in their current state.
- There was confusion on the scoring of Category F (Building/Project Design Parameter) elements. Some felt that the evaluations of these elements are based on whether the design standards exist and are planned to be utilized. The team leader expressed that the evaluation is based on how well the design standards have been incorporated at the present point in time.
- Having the General Contractor represented at this meeting was beneficial as the contractor's perspective on project definition was quite often different than those of the planning side. It may have been inappropriate (from the owner point of view); however, to have the contractor present while evaluating the project cost estimating section as it was made known that the estimates where in fact at a poor state of definition.
- While many areas of project definition warranting further attention were discovered and discussed in this process, no real responsibility/tracking for the newly identified actions items was generated. The impetus of this session appeared to be in carrying out the scoring and not in the identification of further action items.
- The scoring session in itself appeared to generate a good degree of Team Building and Team alignment.
- The team assessed their score as a 265 out of a possible 925.

Lessons Learned:

- A very complete overview of the purpose to the PDRI scoring session needs to be stressed prior to commencement of the scoring session. The philosophy or view of "Lets score how well we are doing" should be substituted by instead stressing, "Lets identify where we can still improve." If the PDRI scoring is viewed as a report card of how well you are doing, the tendency to inflate the present condition may be present. In addition, opportunities for the identification of potential problem areas may be missed.
- A means of tracking the actions that are identified during the scoring process as requiring further attention needs to be established and ready prior to the meeting.
- The Building PDRI lacks an element needed for renovation projects that considers the availability and condition of as built drawings.
- The Building PDRI appears to be general enough to address the needs of building renovation projects with very little modification.
- A discussion amongst the owners with respect to the appropriateness of having the general contractor present while the assessment of cost estimates is made may be warranted.

Ben Barrow

Appendix F: Goddard SFC Initial Screening Matrices

2.3 CoF Project Scoring System

This system (Figure 5.1 and Figure 5.2) identifies discussion factors and provides a risk assessment tool as a basis for objective comparison among a wide variety of requirements. The discussion factors are not directly used in prioritization, but are instead a means to document the issues that underlie the scoring. The risk assessment tool, which is a two dimensional measure of the importance of the project to the institution.

Sample CoF Scoring Matrix

Figure 5.1

	FACTORS						RISK							
		COST		NON-MISSION										
	MISSION	MAINTENANCE/REPAIR	OPERATIONS	SAFETY	LEGAL	MORALE	VERY HIGH - INSTITUTION	HIGH - DIVISION/BUILDING	MEDIUM - BRANCH/AREA	LOW - WORK CENTER	VERY LOW - PERSON	PROBABILITY	SCORE	
PROJECT TITLE														**COMMENTS**
Project 1	●	●		●	●		●					**VH**	**1**	
Project 2	●	●	●					●				**H**	**3**	
Project 3		●		●					●			**M**	**5**	
Project 4				●	●	●				●		**L**	**7**	
Project 5			●			●					●	**VL**	**9**	

Risk Assesment Matrix

Figure 5.2

	PROBABILITY				
RISKS	VERY HIGH	HIGH	MED	LOW	VERY LOW
VERY HIGH - INSTITUTIONAL	1	2	3	4	5
HIGH - DIVISIONAL	2	3	4	5	6
MED - BRANCH	3	4	5	6	7
LOW - WORK CENTER	4	5	6	7	8
VERY LOW - INDIVIDUAL	5	6	7	8	9

CoF Evaluation Process

Directorates submit requests.
Code 221 determines the appropriate program category
Prior to FCC review:

- Code 205 scores the Environmental submissions
- Code 221 scores all other submissions
- Code 221 Staff creates an integrated "Strawman" five-year program

FCC reviews project scoring and finalizes overall program plan.

CoF Scoring Matrix

Discussion Factors:

Mission: Does the project directly impact the Centers' primary mission(s)? Define the impact, and state the mission affected.

Cost Factors:

Maintenance/Repair: If the project is not accomplished, are additional costs to perform the maintenance and repair of Center facilities incurred?
Operations: Will failure to accomplish the project increase the Center's operational costs? (This may include utilities, salaries, or any other operational costs.)

Non-Mission Factors:

Safety: Does the project correct or mitigate known safety problems?
Legal: Does the project correct or mitigate known legal problems?
Morale: Does the project improve morale of the Center's workforce?

Risk Assessment Factors

Severity:

- Very High: Institutional: Millions of Dollars of Impact - There is risk to multiple programs affecting the Center or the impact will be in many areas and buildings. This could be an infrastructure failure like a chilled water line or central plant that shuts down major areas of the site. The impact of the shutdown could be measured in millions of dollars of damage or lost productivity.

- High: Division/Building - Hundreds of Thousands of Dollars of Impact - Risk is to a smaller number of programs usually contained within the same building or division. Failure of the system may result in losses measured in hundreds of thousands of dollars of damage or lost productivity.
- Medium: Branch/Area - Tens of Thousands of Dollars of Impact - Risk is to one or more programs, or portions of programs, in a specific area of a building. Losses will be measured in tens of thousands of dollars of damage or lost productivity.
- Low: Work Center - Risk is to a portion of a program in a single workspace.
- Very Low: Person - Risk is to one or two individuals. This may include work to meet accessibility standards or improve a substandard work environment.

Probability:

- Very High: Certain multiple events, occurring annually - In this case, the events that create the risk already occur on a regular basis. The roof is leaking or the failure of a chilled water line.
- High: One or two likely events per year. - There is a distinct probability of failure, and events are expected. One event may have already occurred.
- Medium: Event could happen anytime. - Due to the age or condition of the facility, or other relative factors, failure is possible at any time.
- Low: Event may happen. - Due to the age or condition of the facility, or other relative factors, failure is possible.
- Very Low: Possibility of event exists. - Due to the age or condition of the facility, or other relative factors, it is reasonable to expect that failure is possible

3.3 Center Funded Project Scoring System

This system (Figure 6) identifies various weighting factors and provides an assessment tool as a basis for objective comparison among a wide variety of requirements. The weighting factors are used to prioritize projects in the order of importance to the institution.

This system includes nine elements intended to focus discussions during project prioritization. These discussions are intended to generate a reasonably objective decision as to whether a project does or does not get the points for a specific element, allowing reasonably valid comparisons among varied requests.

Sample Center Funded Scoring Matrix

Figure 6

WORK REQ #	FUND PRIOR	FCC PRIOR	CODE	DESCRIPTION	TOTAL SCORE	MISSION	PAYBACK	BUSINESS OPPORTUNITY	PERSONNEL IMPACT	DIVISION PRIORITY	URGENCY	POLITICAL	PROJECT CONFIDENCE	FCC MARK
					17	3	2	1	3	2	2	2	2	+/-
0001	1		100	Project 1	17	X	X	X	X	XX	X	X	X	-
0002	1		200	Project 2	16	X	X	-	X	XX	X	X	X	-
0003	2		300	Project 3	15	X	X	-	X	X	X	X	X	-
0004	1		400	Project 4	14	X	-	-	X	XX	X	X	X	-
0005	1		500	Project 5	13	-	X	-	X	XX	X	X	X	-
0006	2		200	Project 6	12	-	X	-	X	X	X	X	X	-
0007	3		300	Project 7	11	-	X	-	X	-	X	X	X	-
0008	2		400	Project 8	10	-	-	-	X	X	X	X	X	-
0009	3		500	Project 9	9	-	-	-	X	-	X	X	X	-

The CF Evaluation Process begins with the submission of requirements by Directorates. The Planning Office performs the initial evaluations for all of the Greenbelt's Directorate and Institutional submissions. Code 205 performs the initial evaluations for all Safety and Code Compliance submissions. The Wallops' FCC performs initial evaluations for the Wallops' submissions. Once initial evaluations are completed, the FCC reviews and approves project scores and allocates funds among program categories.

Mission:

Does this request have the potential to directly impact the Center's primary mission; i.e., produce spacecraft on schedule, process data on schedule, or conduct scientific experiments on schedule.

Payback:

Payback considers that the impact of a particular project can be identified and measured in economic terms. This includes:

- Reduced operating or other definable expenses likely to equal the project cost in 7 years or less.
- Reduced risk of significant failure or loss of life, property, or operations likely to exceed the project cost.

Business Opportunity:

Does this request create new strategic business opportunities for the Center. Are future requirements known? What is the length of requirement? Does the project leverage past investments? Are multiple programs supported by the project? Does the project cover potential evolving requirements of future science programs?

Personnel Impact:

Will the project impact morale and health? Are a significant number of people moderately impacted or is a single individual highly impacted .

Division Priority:

How does the customer prioritize the request? 1 = High Priority, 2 = Medium Priority, 3 = Low Priority

Urgency:

Can the project be deferred to a future year or is an alternative funding source available?

Political:

Is it plausible that the project will affect the public image of Goddard? Are we in compliance with the law? Would the mainstream press likely report on a failure resulting from not executing this request?

Project Confidence:

To earn the points, both of the following questions must be answered yes:

- Has an appropriate engineering solution been identified?
- Will the project address the problem fully and lastingly?

FCC Mark:

This scoring system is useful as a rule, but is not sufficient to prioritize all possible requirements accurately. This element allows scoring adjustments (up or down) during Planning Office or FCC reviews.

Appendix G: NASA PDRI Scoring Session

1 November 1999
Johnson Space Center Bldg 45, Houston Texas

Background: In October 1999, NASA's Johnson Space Center (JSC) obtained funding approval for the construction of an 11,300 SF, $1.2 MM Child Development Center (CDC). The new CDC is intended to replace an existing one and to provide for additional capacity as well as provisions for future expansion. The existing CDC is rapidly becoming functionally obsolete and is faced with safety problems such as rotting flooring. The new CDC is sited at a separate location and once complete, there is a strong possibility that both the old and new CDCs will be operating concurrently for a brief period of time. The desired project completion date is prior to the new school year (August 7, 2000). The project was awarded to a Design-Build contractor who after the recent receipt of the 90% design submittal, has terminated the A/E contract and has since re-contracted out the design effort. The termination was based on the apparent "over design" of the CDC whose construction estimate greatly exceeded the budgeted contractual amount. The purpose of this scoring meeting was to conduct an evaluation of the project planning efforts at the present point in time by utilizing the NASA-specific PDRI. This is the first time the NASA-specific PDRI was used to assess the planning of a NASA project. The scoring of the PDRI was facilitated by UT professionals and carried out by representatives from: NASA project management, NASA contracting, NASA estimating and design, customer, general contractor, safety consultants, and operations and maintenance consultants. (20 personnel in total) Attachment A is a listing of the meeting attendees. The evaluation took approximately three hours.

Scope: To examine the use of the NASA-specific PDRI to evaluate the planning efforts associated with an actual NASA project in order to:

- Note its overall validity to NASA projects.

- Note changes necessary to render it more useful to NASA projects.
- Note the overall scoring process and see if improvements could be made.
- Capture project definition action items identified due to its use.

Observations:

- The use of an impartial facilitator to head the project scoring efforts and to prompt a fair-minded scoring philosophy led to a rational and orderly assessment and greatly eliminated the general tendency of participants to focus on "getting a good grade."
- The use of a non-weighted score sheet seemed appropriate as it removed the tendency to let the weights influence the evaluation.
- As the scoring process progressed, some large areas of non-definition were discovered, creating a heightened sense of the value of the PDRI. As the poorly defined elements were identified, it started to become clear that three major areas of concern were associated with this project. These were: 1) Estimating issues leading to the risk of exceeding budgetary constraints 2) Scheduling issues leading to the risk of exceeding the desired completion date and 3) Regulatory jurisdiction issues requiring definition. The factors influencing the likelihood of not meeting the project scheduling and budgetary objectives were clearly identified through this process. Attachment B lists the project definition action items as well as their associated PDRI element scores summed up to generate the relative risk values.
- The scoring session in itself appeared to generate a good measure of team building and team alignment. In some cases, it appeared that the scoring session was the first opportunity for some of the difficult issues to be brought out in the open to all pertinent parties.
- Only one element was found to be not applicable to this particular project:

  E4. Stacking Diagrams 13 points
- No additional elements (to those already contained in the NASA-specific PDRI) were found necessary to assess the definition of this NASA project.

- The NASA-specific PDRI was found to capably address the planning definition assessment needs of this actual NASA project. The modifications and NASA-specific comments were found to be helpful and relevant. Many encouraging comments confirming the effectiveness and value of the developed PDRI were voiced by the project team members.
- The presence of the Contracting Officer at this meeting was valuable. His perspective contributed greatly to the definition discussions and he walked away with a sense of the major risk contributors to this project.
- Having the General Contractor represented at this meeting was beneficial as the contractor's perspective on project definition was quite often different than those of the planning side.
- The absence of the newly assigned A&E at this meeting was greatly missed. Many of the action items involved the conveying of information and concerns to the A&E. Also of great value would have been the presence of the recently terminated A&E. Their input could have confirmed some of the areas requiring increased communication and the basis of some of the budgetary concerns.
- The team assessed their score as a 272 out of a possible 987.

Conclusions/Recommendations:

- The PDRI scoring session at this critical point in time was of tremendous consequence to the JSC project management team. It highlighted poorly defined areas, determined the project's major risk issues, provided a constructive exchange of ideas, and promoted alignment between the customer, the project team, and the contractor. The action list (Attachment B) generated as a by-product of the scoring process, is priority ranked by relative risk values and serves as a focusing tool for the project team.
- The NASA-specific PDRI appears to be capable and ideally suited to address the needs of NASA project planning teams.
- It is recommended that a meeting with the newly contracted A&E team be conducted in the near future to go over the concerns revealed during the scoring session and the action items depicted in Attachment B.

- It is recommended that future NASA projects be assessed at earlier points during the project definition stage where greater capacity to influence the project's successful outcome exist.

	CDC PROJECT PDRI SCORING SESSION ATTENDEES Novemeber 1, 1999 JSC, Houston, TX		
	Name	Org Code	Phone number
1	Joe Tucker	BRSP	(281) 483-4818
2	Charley Stamps	G&C Contracting	(281) 480-7401
3	Zak Zaky	G&C Contracting	(281) 335-7509
4	Ben Richardson	GBC JA151	(281) 483-9974
5	Rod Etchberger	JSC BJ33	(281) 483-3200
6	Henry Wyndan	JSC JA151	(281) 483-3188
7	Pat Kolkmeier	JSC JA16	(281) 483-8530
8	Bob Kehoe	JSC JA16	(281) 483-3149
9	Steve Capmbell	JSC JA161	(281) 483-3200
10	Don Apisa	JSC JA161	(281) 483-2355
11	Leroy Bessix	JSC JC2	(281) 483-8019
12	Doug Conover	JSC JC3	(281) 483-3130
13	Joe Gardner	JSC JC3	(281) 483-3190
14	Richard Holzhpfel	JSC NT2	(281) 483-8019
15	Jim Robinson	Muniz Engineering	(281) 483-6362
16	Pamela Baughman	Muniz Engineering	(281) 244-5644
17	Tim Boycs	NASA/ Budgeting	(281) 483-1838
18	Ben Barrow	UT	(512) 471-7651
19	Edd Gibson	UT	(512) 471-4522
20	Todd Graham	UT	(512) 471-8508

Attachment A

CDC Project Scoring Session Action Items

Item #	PDRI Element(s)	Relative Risk Score	Item Description
1	C2, D4, F6	32	Resolve issues as to which code to follow for design/construction (City vs. JSC)
2	C6	29	Issue revised cost estimate. Issues of concern include: switching to JSC code, confirmation of Int/Ext. finishes, mechanical/electrical design, permanent fence, fire protection needs: interior viewing windows, kitchen & utility equipment, refrigeration, etc
3	C5, K3	23	Submit new schedule (Zak) based on new A/E design time and compare with Henry's worst case. NASA to determine schedule submittal and updating requirements
4	A4, D4, E1	14	Establish appropriate ADA requirements (net vs. gross area of CDC)
5	E8, E12, G3	12	Resolve issues around kitchen / utility equipment and refrigeration
6	F2	12	Resolve outstanding architectural design issues.
7	C3, D6	11	Confirm water supply availability (fire & potable) for operating both old and new facilities together
8	C3, D7	11	Confirm fire communication line routing (question about splicing and junction boxes)
9	F4	11	Resolve outstanding mechanical design issues.
10	A4, G3	8	Use of gas utilities vs. electrical
11	A6	7	Clarify ease of expansion issues (where & how future expansion will occur)
12	H1	7	Commence procurement of structural steel, HVAC equipment, and other long lead items to ensure timely delivery.
13	B4	6	Communicate in writing to new A/E that exterior theme is "Western"
14	B3	5	Hours of operation need defining
15	B2	5	Resolve Executive Order 13101 issues concerning sustainable construction (recycled carpet, fly ash, etc.)
16	F3	5	Resolve structural issues concerning columns vs. full span and wind loads on roof
17	F5	5	Resolve outstanding electrical design issues.
18	E6	4	Clarify requirements for fire protection, interior aisle (1 hr rating) and viewing windows (25% of wall space)
19	F1	4	Modify scope of work to reflect customer funding of permanent fence. Customer to secure funding for fence
20	K1	4	Determine QC/QA requirements and responsibilities
21	A5, E1	3	Clarify square footage of CDC (11,360 SF net vs. gross)
22	F8	3	Issue preferences for audio visual locations, equipment and cable types to new A/E
23	A4	2	Communication of expectations to A/E on economic analysis of gas vs. elec.
24	J2	2	Develop list of spare parts to be turned over at job completion

Attachment B

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Vita

Benjamin John Barrow was born in Manhattan, New York on June 11, 1962, the son of Oscar Ramos Barrow and Anna Rose Barrow. He graduated from Sandia High School in Albuquerque, New Mexico in 1980 and served in the United States Navy as a nuclear trained Electrician's Mate on board the USS Alexander Hamilton SSBN 613 (Gold). In 1982, he received a Naval ROTC scholarship and attended the University of New Mexico. He graduated with a Bachelor of Science degree in Mechanical Engineering in May 1987 and was commissioned as an Ensign in the US Navy. Following Nuclear Officer training and Submarine Officer School in Groton, CT, he served aboard the first Trident Missile Submarine, USS Ohio SSBN 726 (Blue). In 1994, he voluntarily transferred into the US Navy Civil Engineer Corps and has served as Contract Quality Director at Naval Submarine Base, Bangor, and as the Public Works Officer and Executive Officer at Naval Support Activity, La Maddalena, Italy. In January 1999, he entered The Graduate School at the University of Texas at Austin.

Permanent address: P.O. Box 374
Manchester, WA 98353

This thesis was typed by the author.